Life on the Mid-Atlantic Ridge

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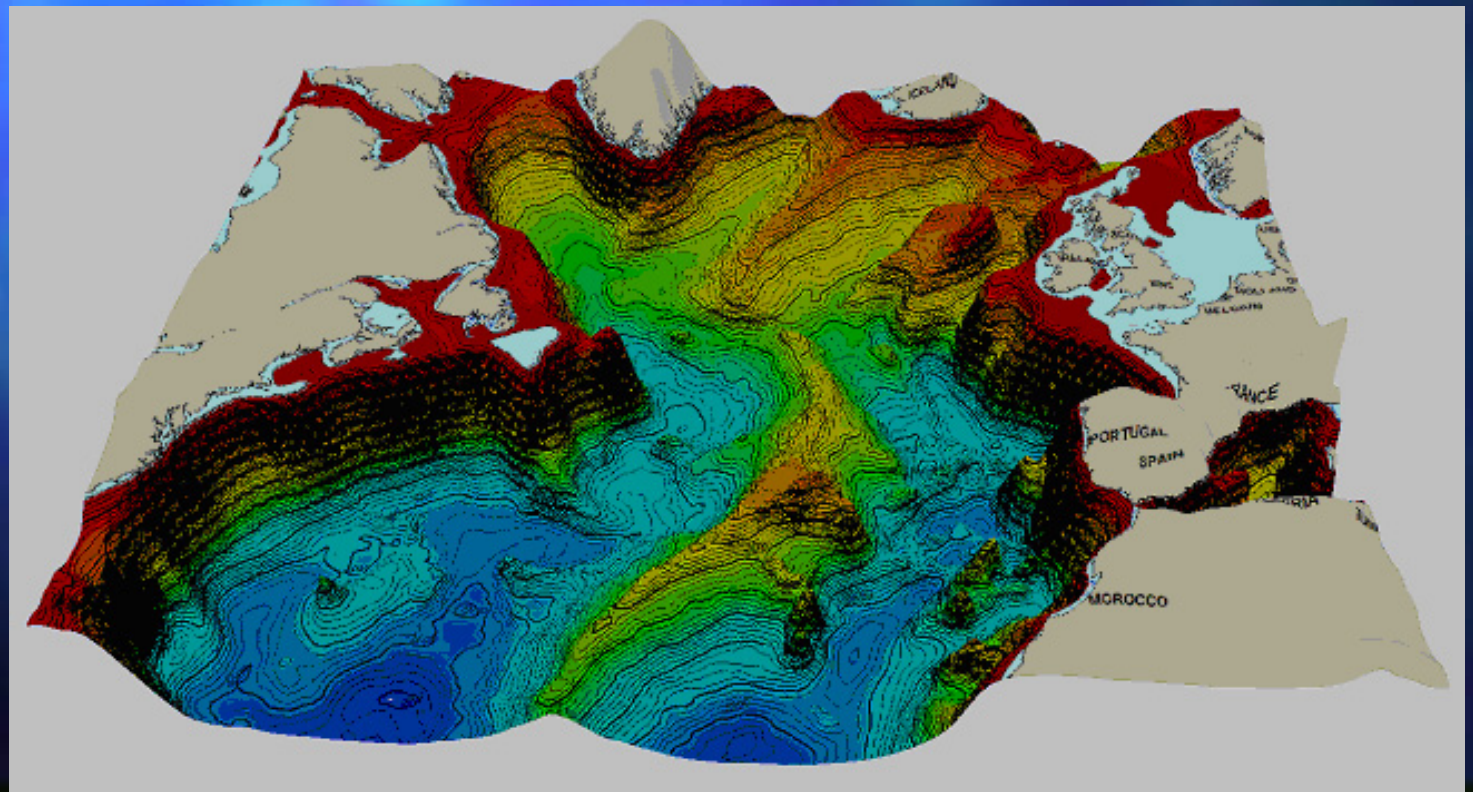
MAR-ECO

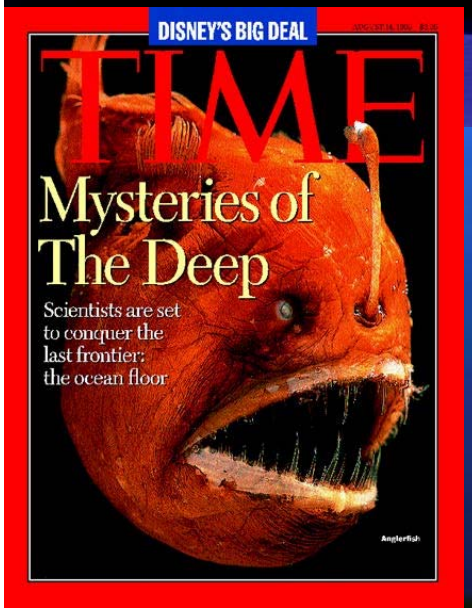
www.mar-eco.no

The Census of Marine Life pilot project

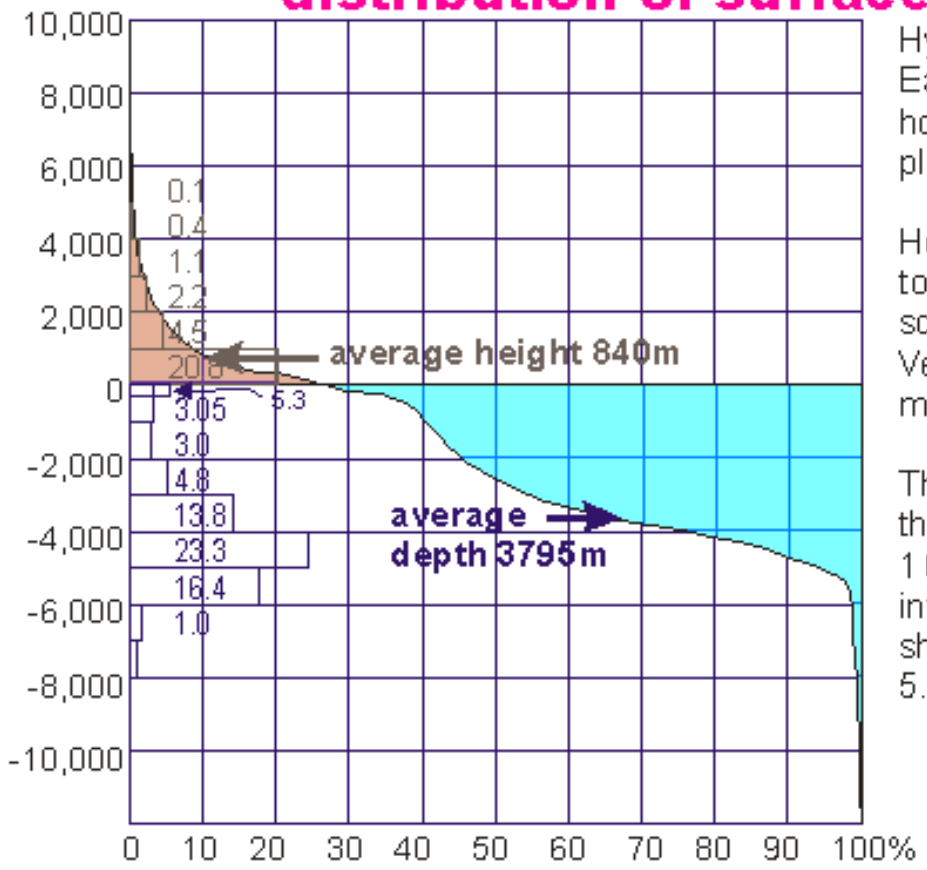
PATTERNS AND PROCESSES OF THE ECOSYSTEMS OF THE NORTHERN MID-ATLANTIC



The largest, but least known, ecosystem on earth



distribution of surface area

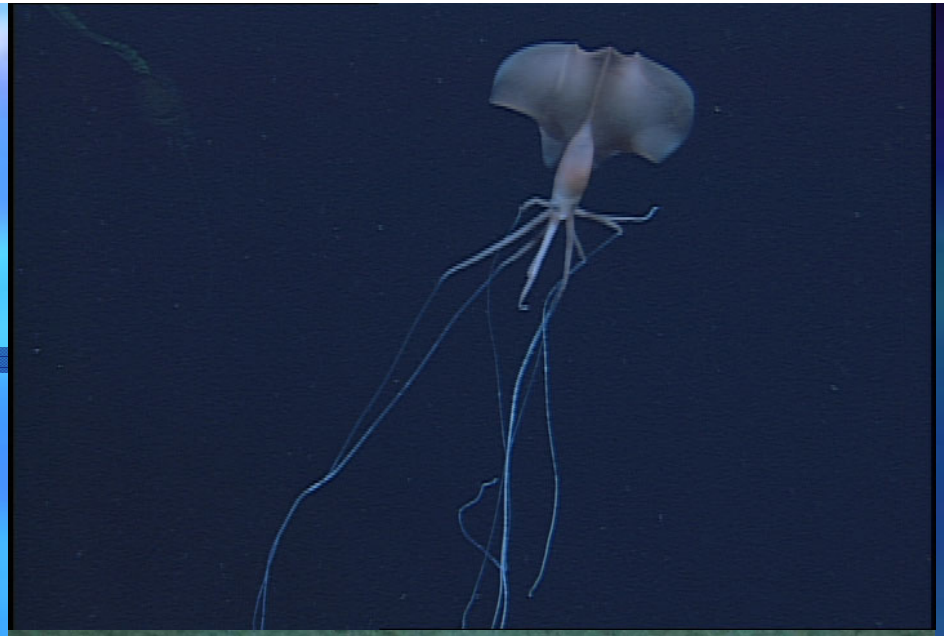


Hypsographic curve of the Earth's surface, showing how the surface area of the planet is distributed.

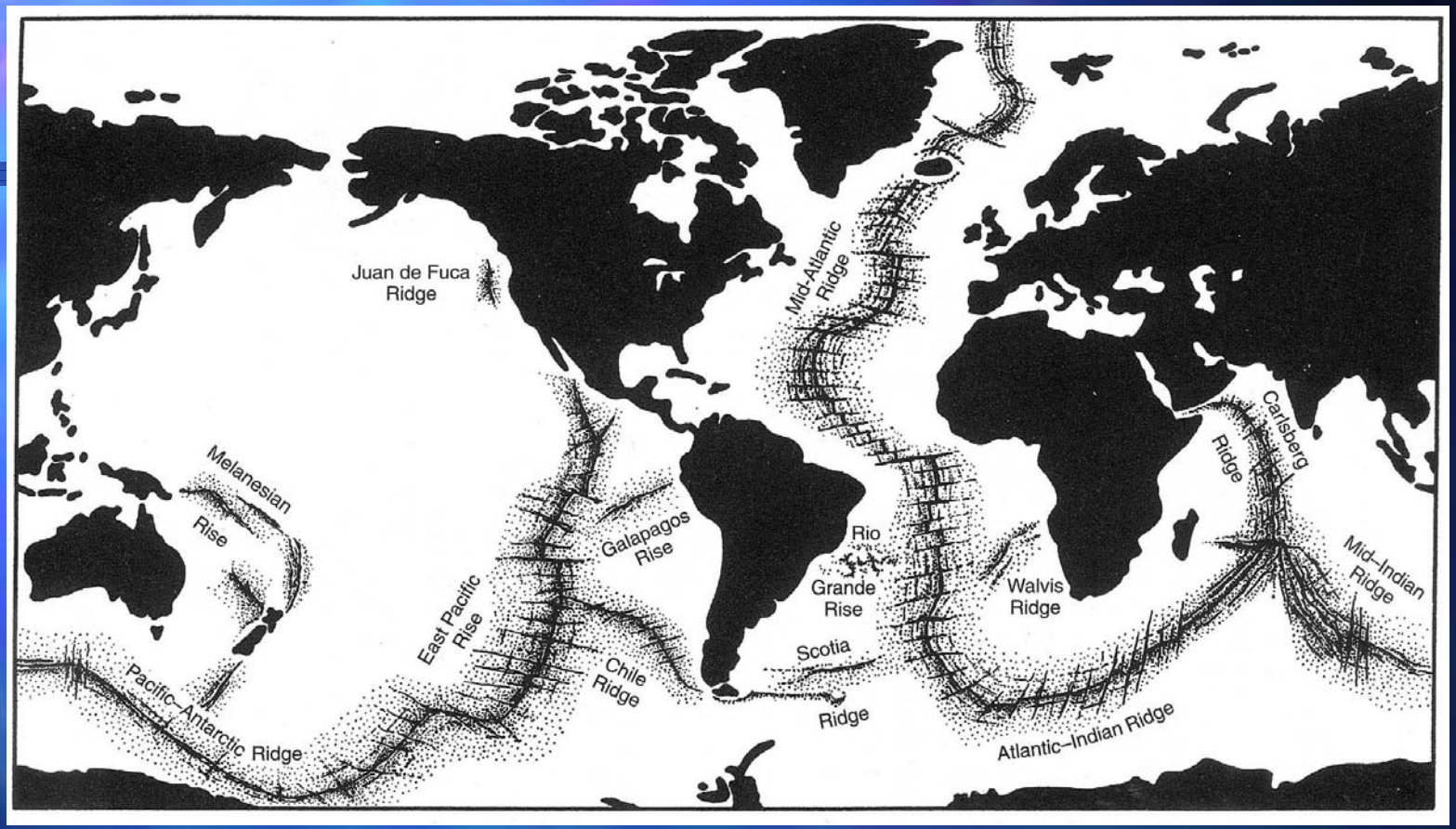
Horizontal: percentage of total area (5.2 million square km)
Vertical: height or depth in metres.

The histogram on left shows the percentages for each 1000m height/depth interval. The continental shelf to -200m represents 5.3%

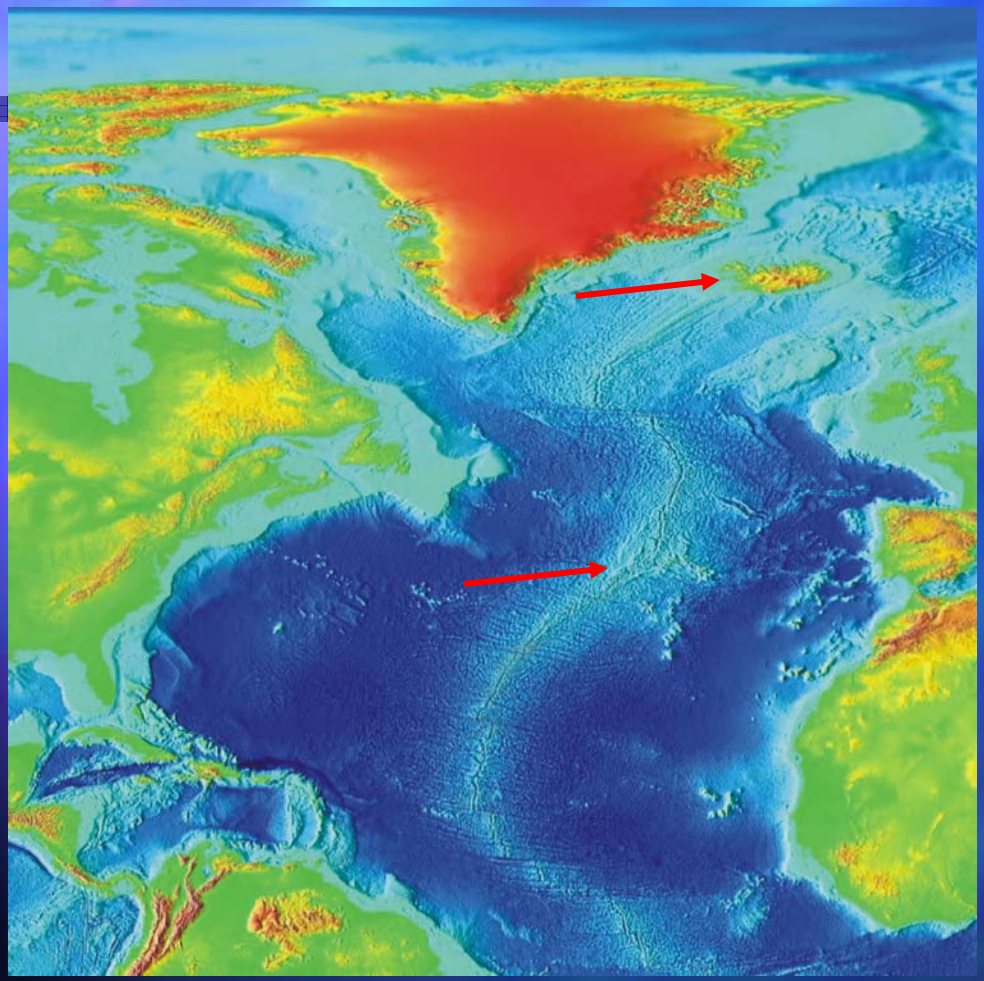
Benthic vs Pelagic



Two dimensions vs four



The global ocean ridge system (after Garrison, 1993)



Area:

Iceland – Azores

Taxa/components:

Pelagic, benthopelagic and epibenthic macrofauna.

Fishes, cephalopods, gelatinous plankton, crustaceans.

Planning phase: 2001-2003

Field phase: 2003-2005

Analytical phase: 2004-2008

Main aim

To describe and understand the patterns of distribution, abundance and trophic relationships of the organisms inhabiting the mid-oceanic North Atlantic, and identify and model ecological processes that cause variability in these patterns.

International Steering Group

Norwegian Core Group

Public Outreach Group

Component themes:

Support projects:

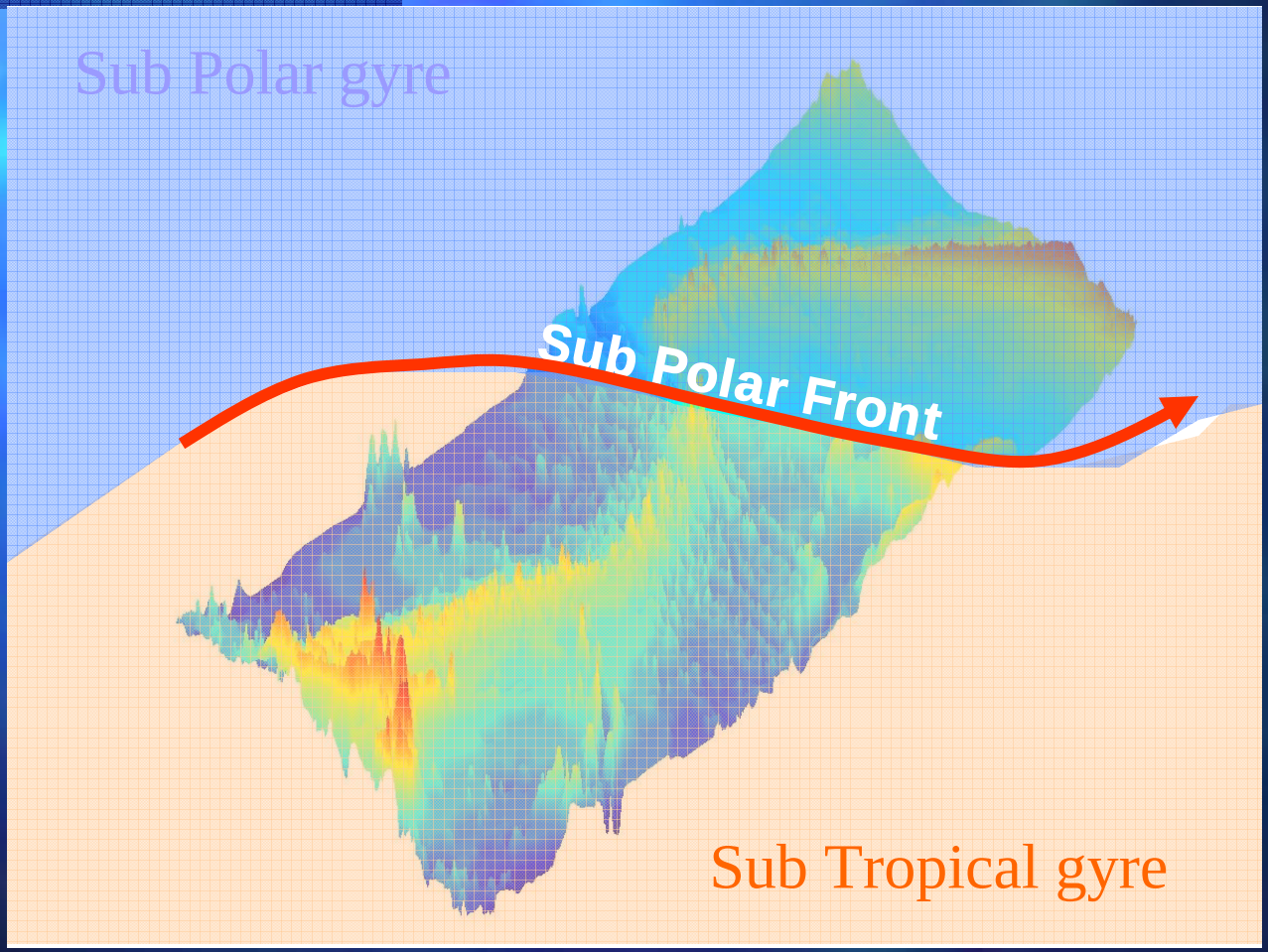
Data mining

Technology Methods

Environment

- bathymetry, substrate
- oceanography

What are we looking for?



Central questions

- Are the MAR communities extensions of the communities inhabiting the North Atlantic continental slope regions?
- Is the MAR a barrier between the pelagic fauna of the east and west North Atlantic basins? Is there a difference in species occurrence either side of the MAR?
- Do circulation features, such as the north Atlantic Current and north Atlantic Drift, act as barriers between the northern and southern fauna? In the region of the north Atlantic Current, what is the effect of eastward drift and import of material from the west?
- What is the significance of individual seamounts within the ridge system?
- Is the trophic structure of the northern mid-Atlantic ecosystem similar to that on the slope regions of the eastern and western sides of the Atlantic?

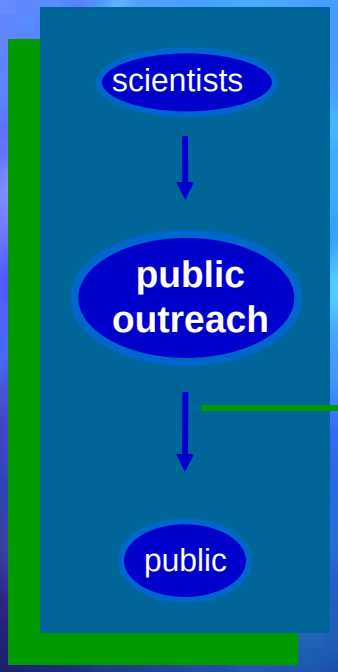
Tasks

Task 1: Mapping of species composition and distribution patterns (identity, distribution, genetics)

Task 2: Identification of trophic interrelationships and food-web patterns

Task 3: Analyses of life history strategies

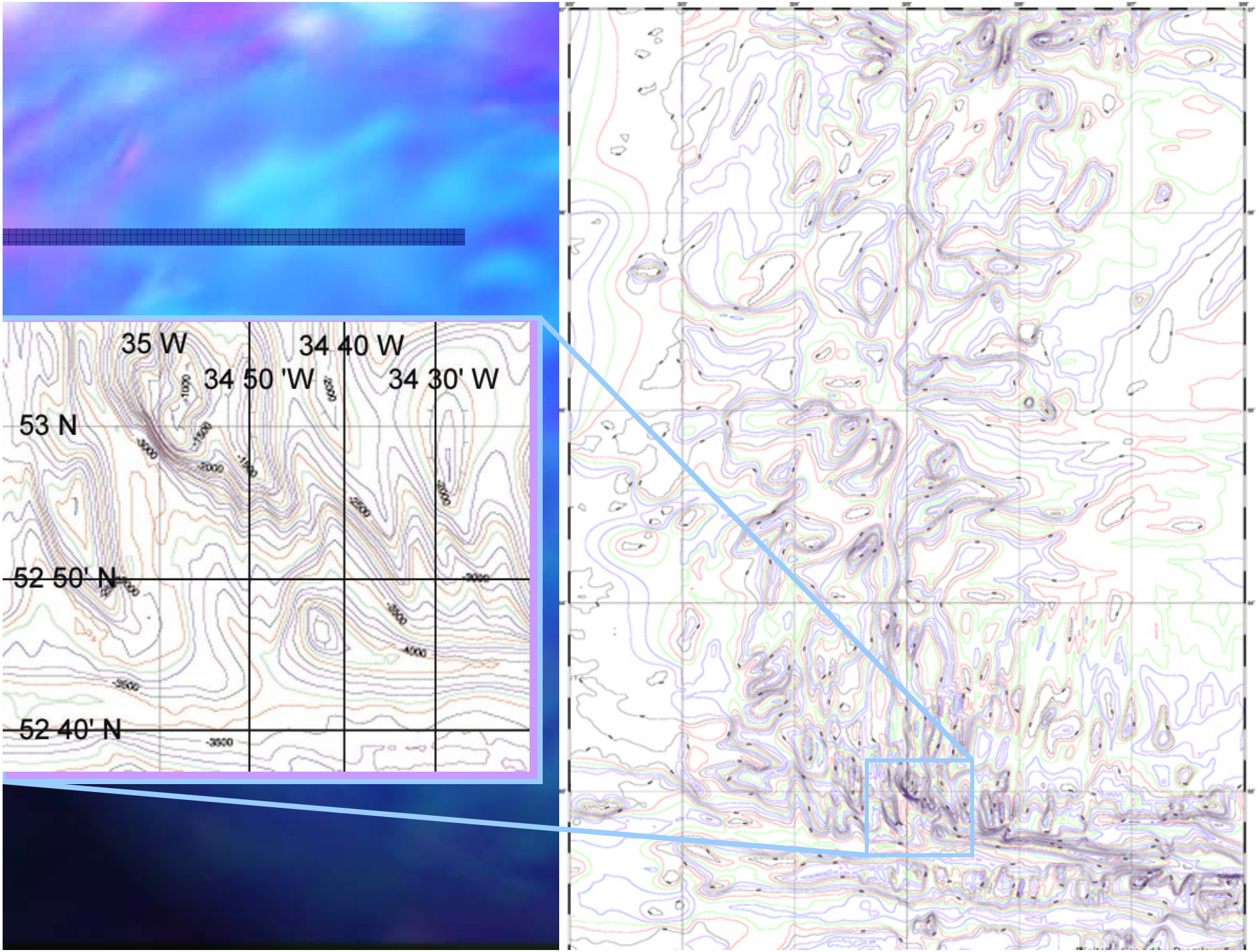
MAR-ECO Public Outreach modules



- film documentary, other video material
- communication network and classroom contacts
- publication projects
- exhibitions
- web support

A multi-dimensional approach to ensure public participation in the project

2003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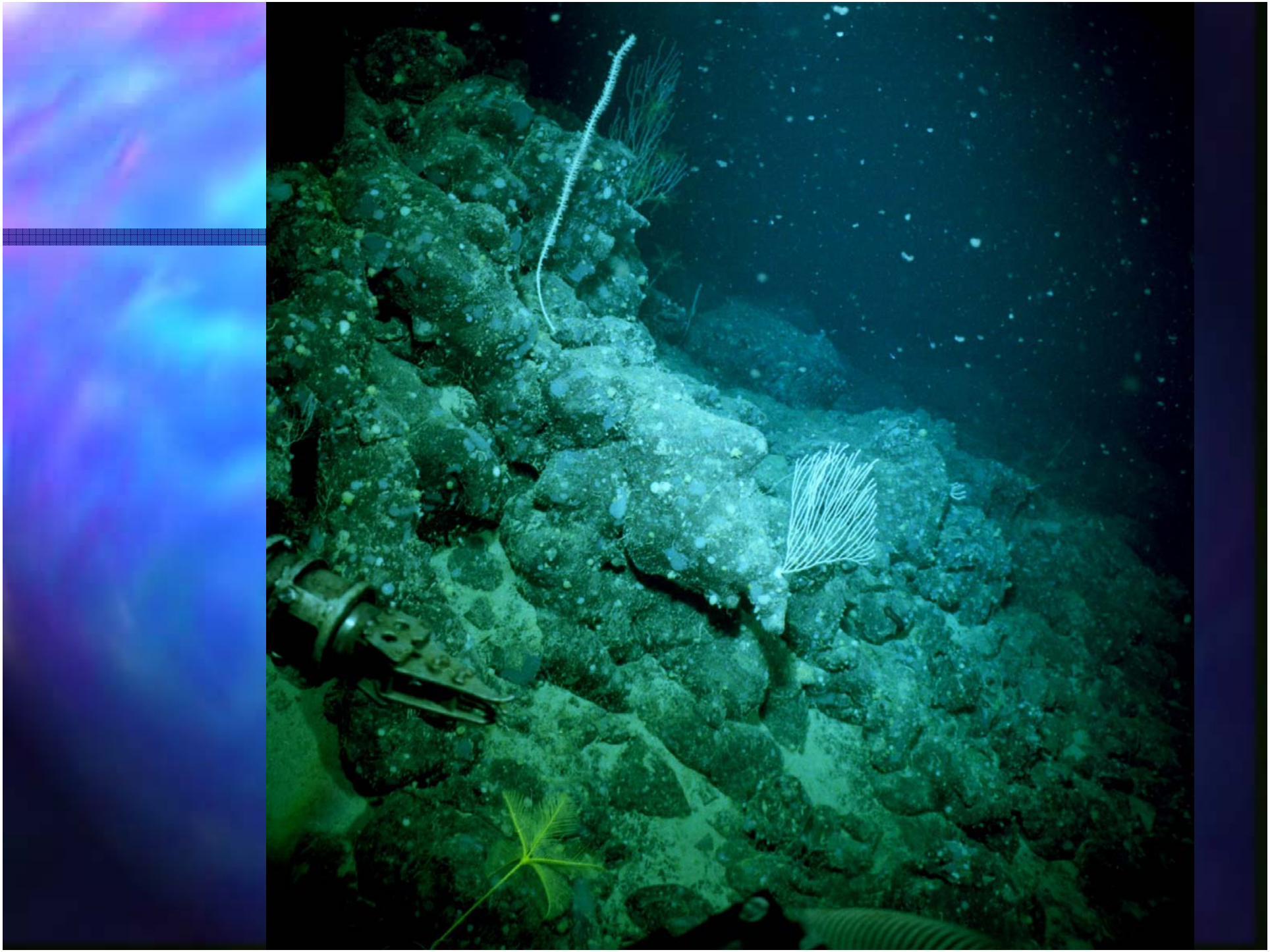
53 N
52 50' N
52 40' N

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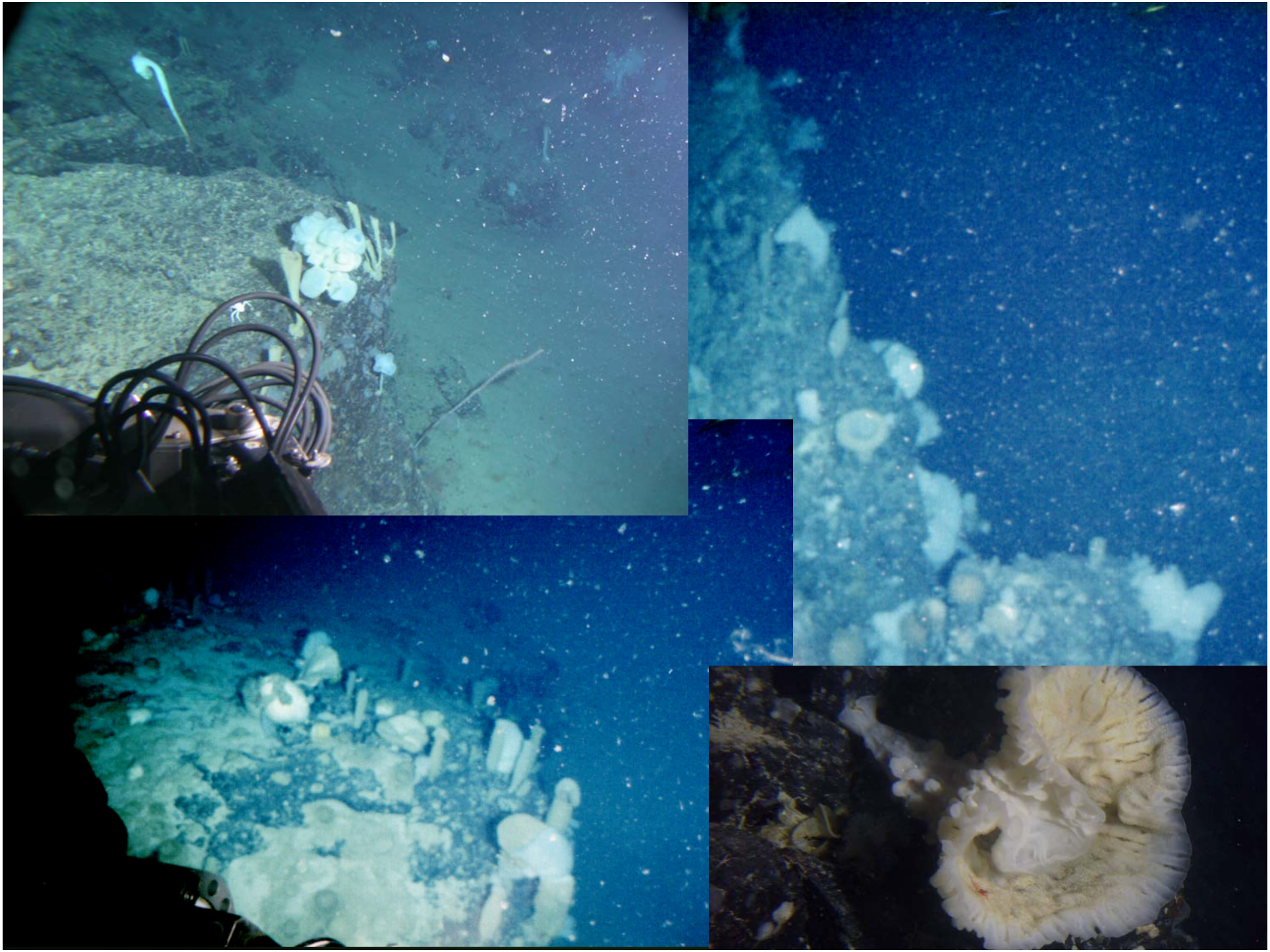


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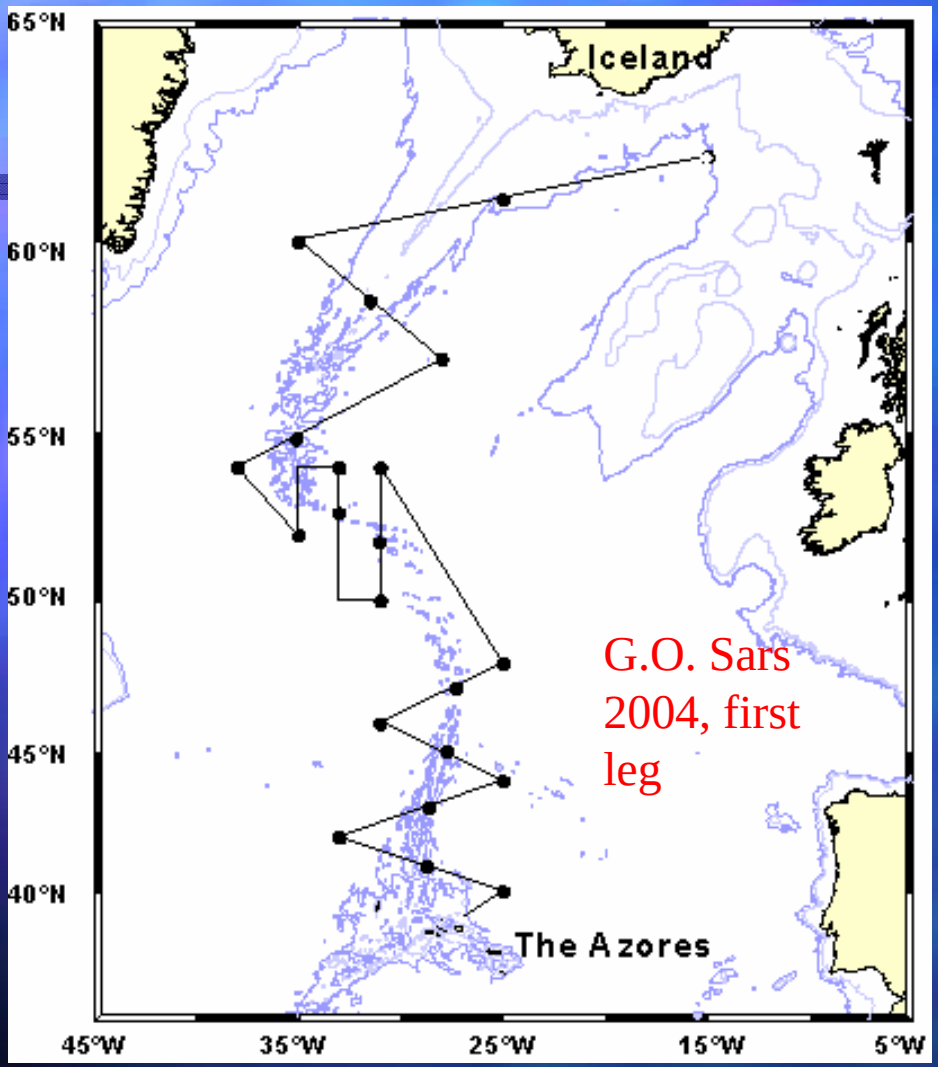
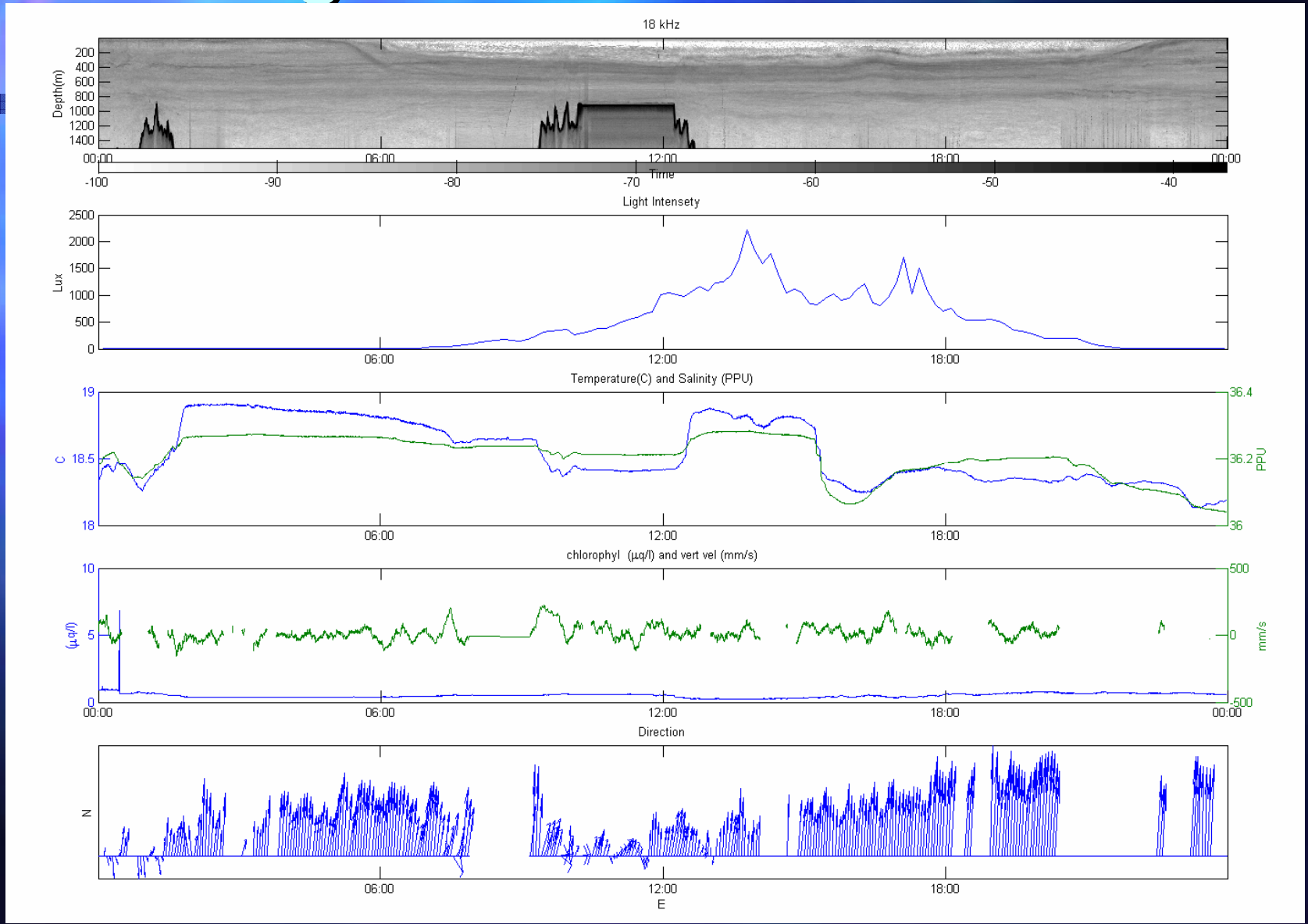
2004



- *G.O. Sars* 2004,

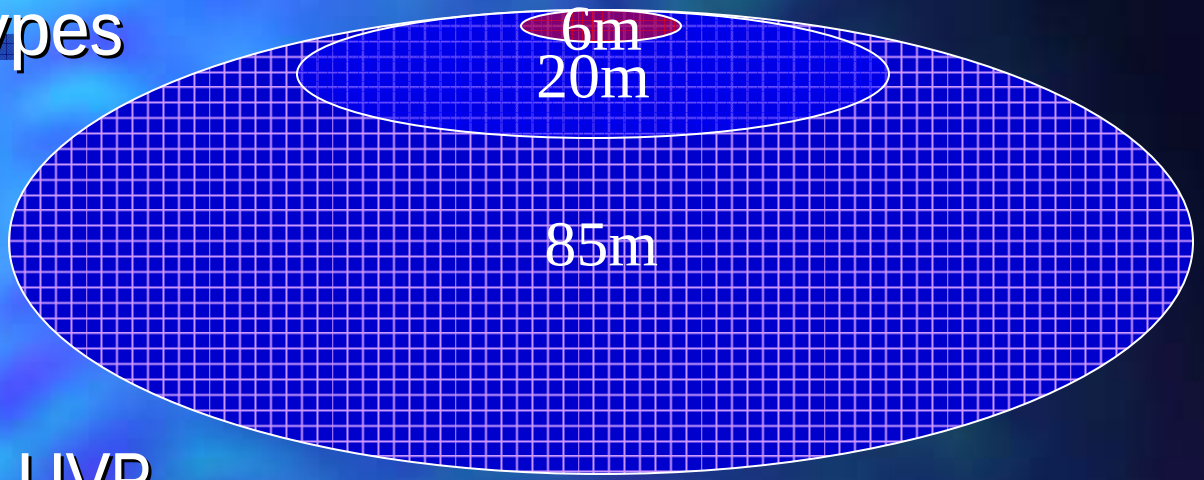
First leg: pelagic nekton and zooplankton survey (acoustics, optics, net sampling, midwater trawling, AUV)

Cruising stations



Fixed station

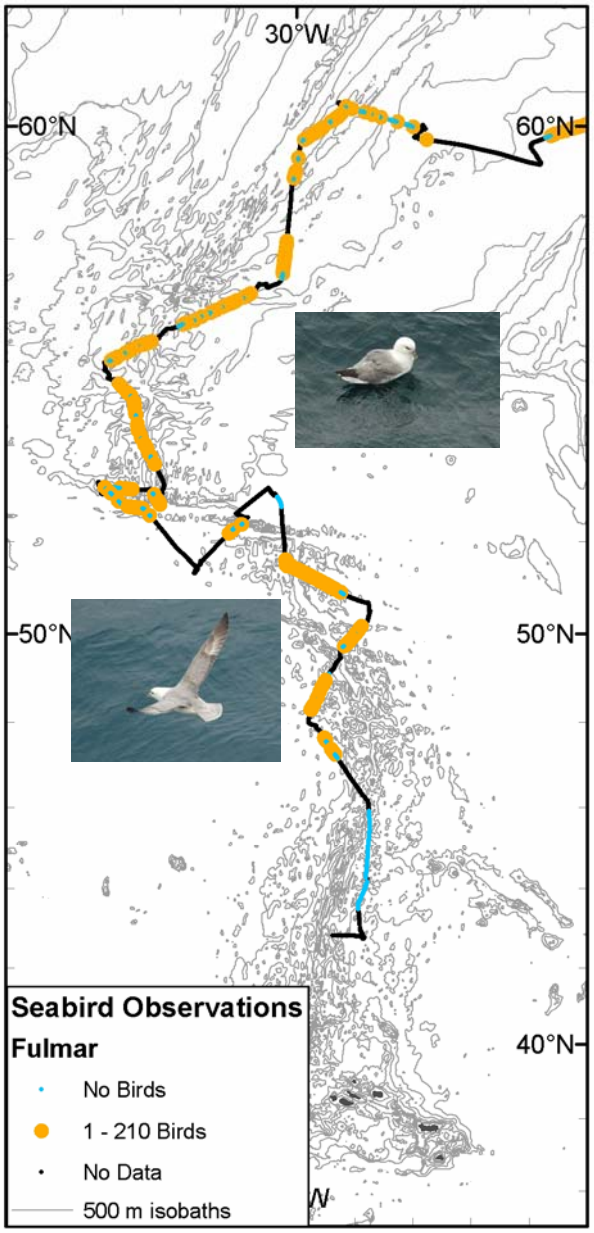
- Towed nets – 3 types
  - Multisampler
- Vertical nets
  - Multinet
  - Juday net
- Optical profiling – UVP
- Acoustics –
  - Towed transducers (two frequencies)
  - Current profiles (LADCP)
- Temperature, salinity profiles (CTD)



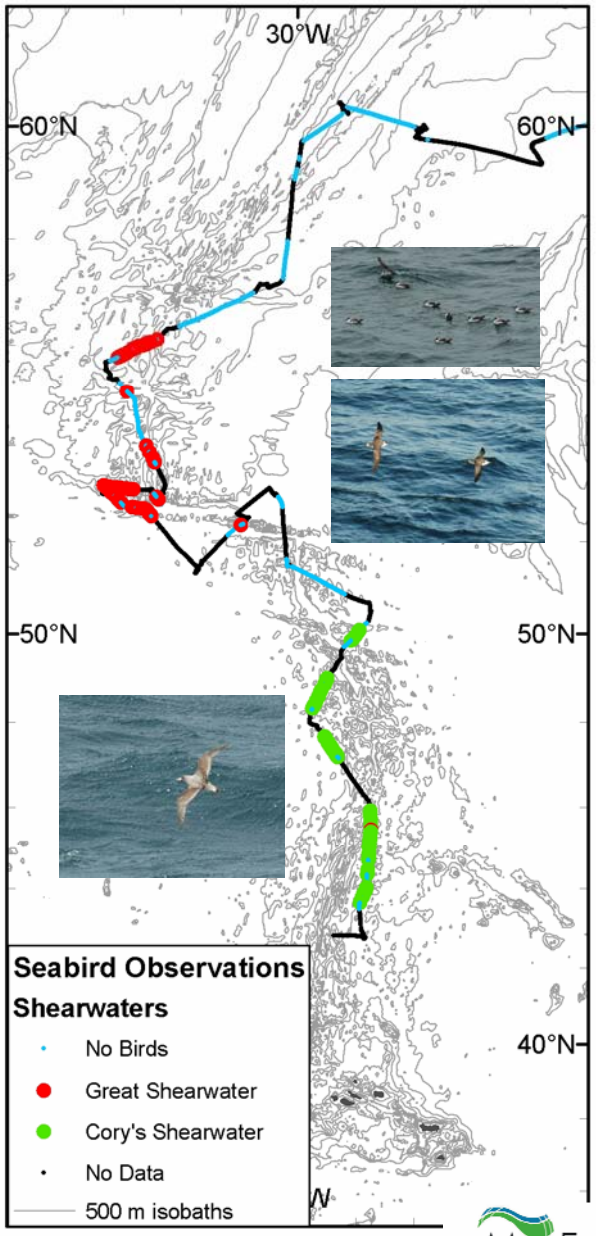
Opportunistic sampling

- Extra tows to validate changes in acoustic recordings
- Sea mammal scouting, tagging and biopsy sampling

Birds



N=1973 seabirds observed



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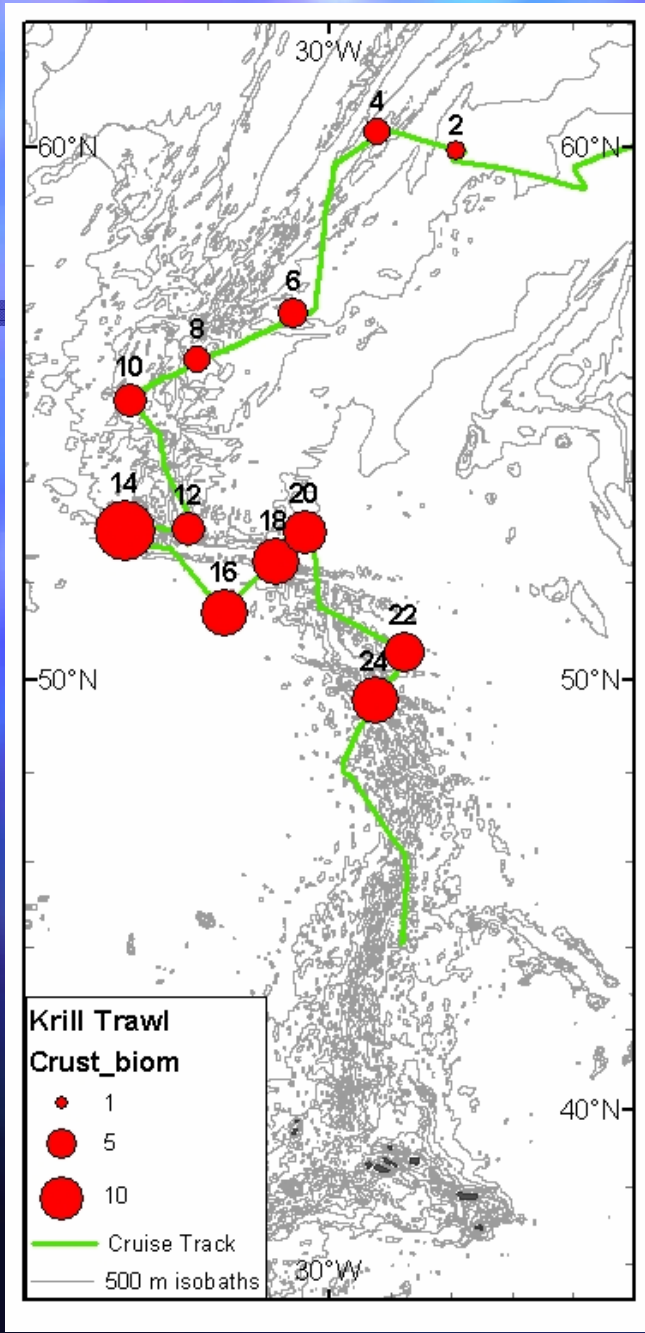
Medium and Long-term Moorings

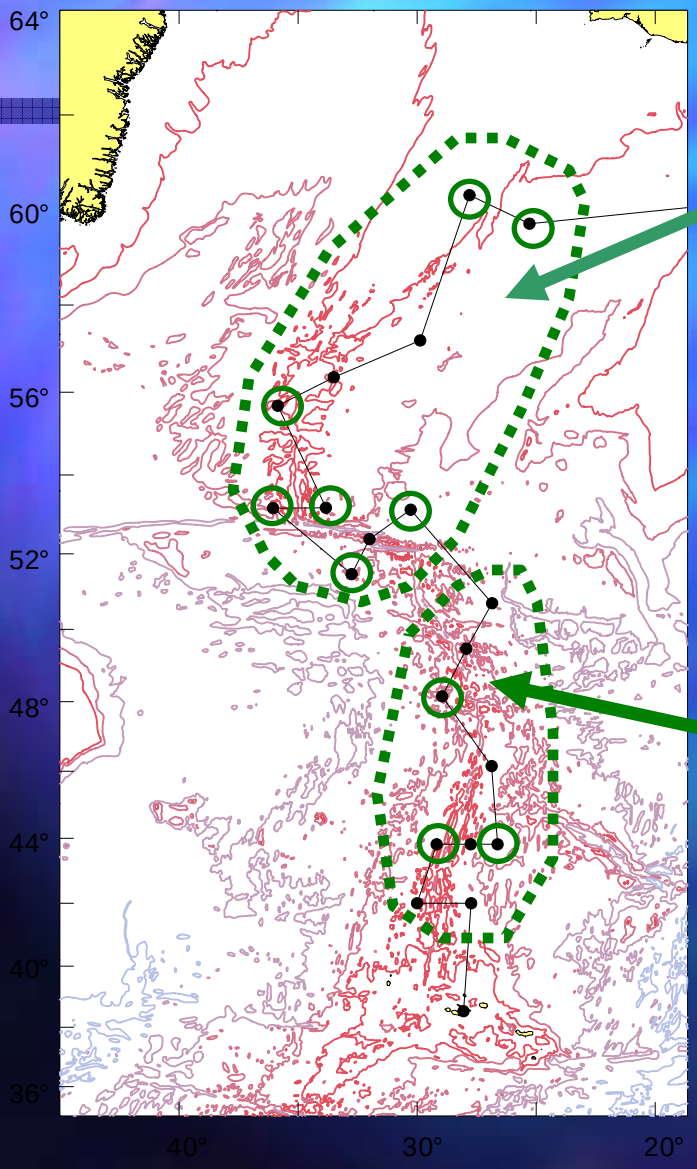
- 1 DOBO lander from OCEANLAB Univ. Aberdeen.
  - Video footage of organisms attracted to successive bait batches.
- 3 IMR Bergen Acoustic landers.
  - Diurnally and seasonally resolved acoustic backscattering data from SIMRAD EK60, plus current data (Aanderaa Instruments).

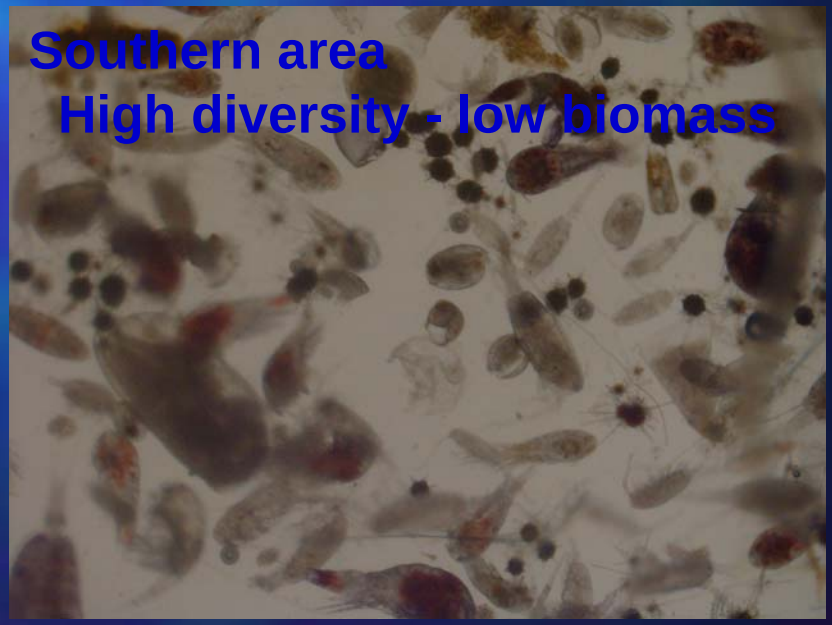
MAR-ECO

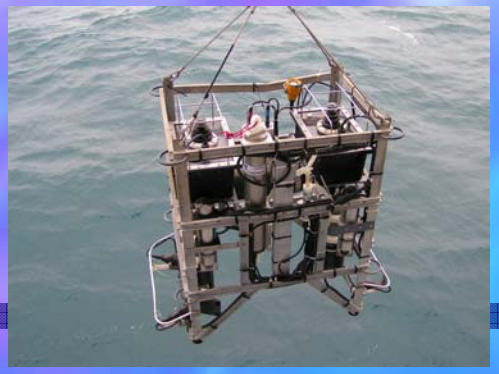


Macro-zooplankton Crustaceans

Mesozooplankton latitudinal differences

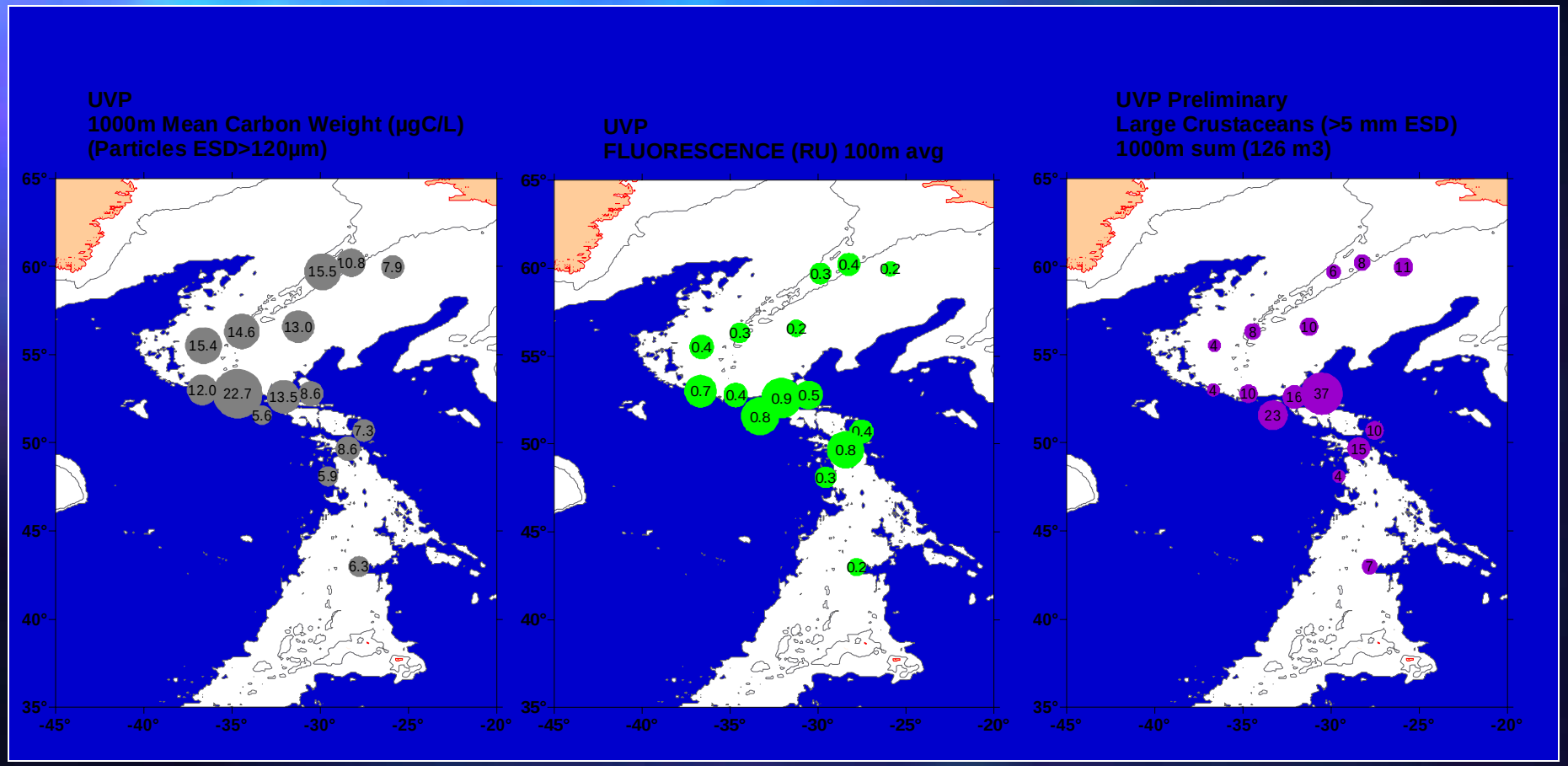






Underwater Video Profiler

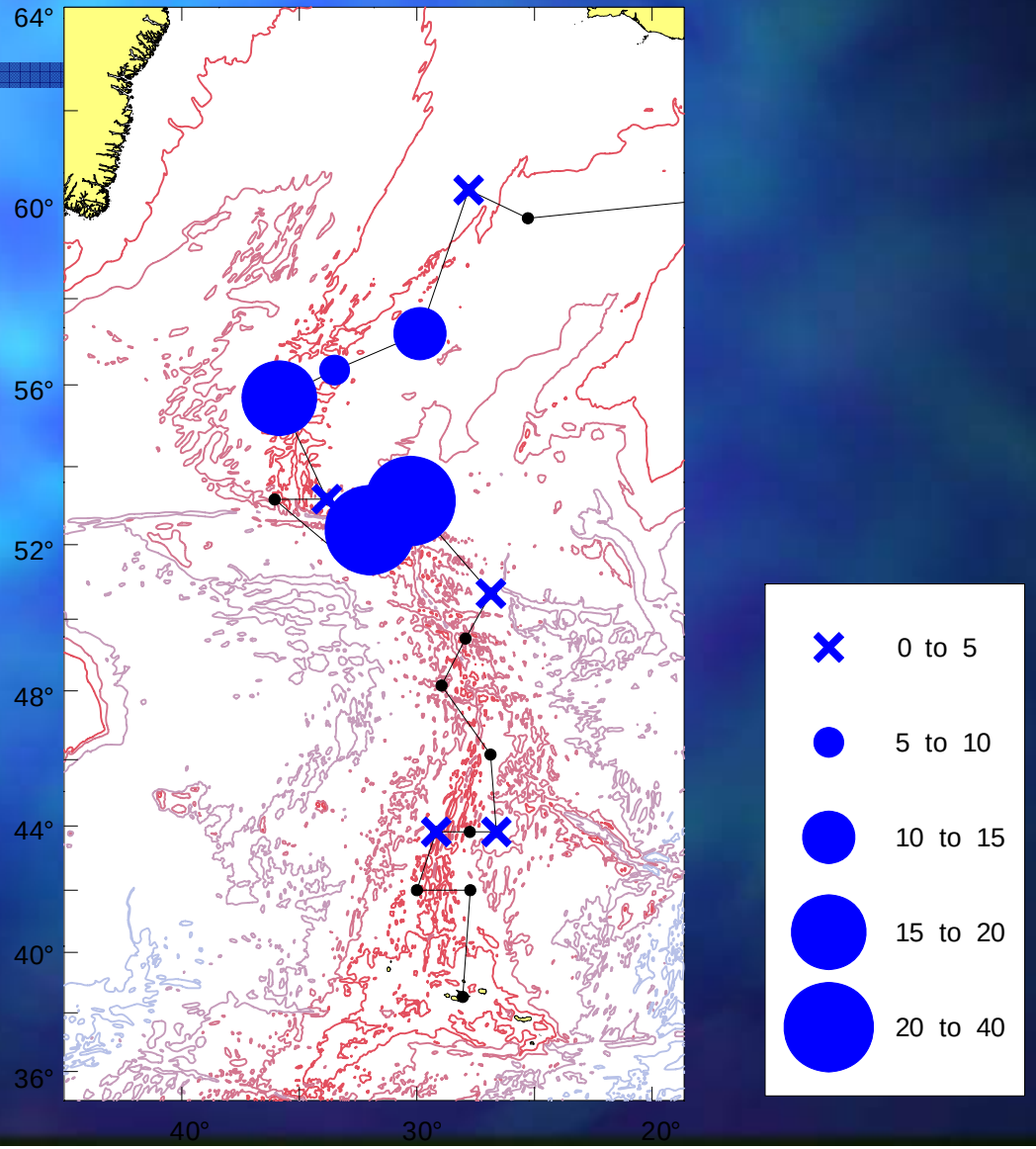
19 stations



Process studies

Calanus sp.

Egg production (eggs female^{-1} day^{-1})



Pelagic Fishes

- 16 Orders

52 families

186 species

– 57,884 specimens

- Community structure
  - Species distribution
    - Relation to Ridge axis
    - Relation to latitude
- Trophic relationships
  - Gut content, Stable isotopes, fatty acids
    - Relations within pelagic zone
    - Food source for demersal nekton

Cephalopod diversity at the mid Atlantic Ridge

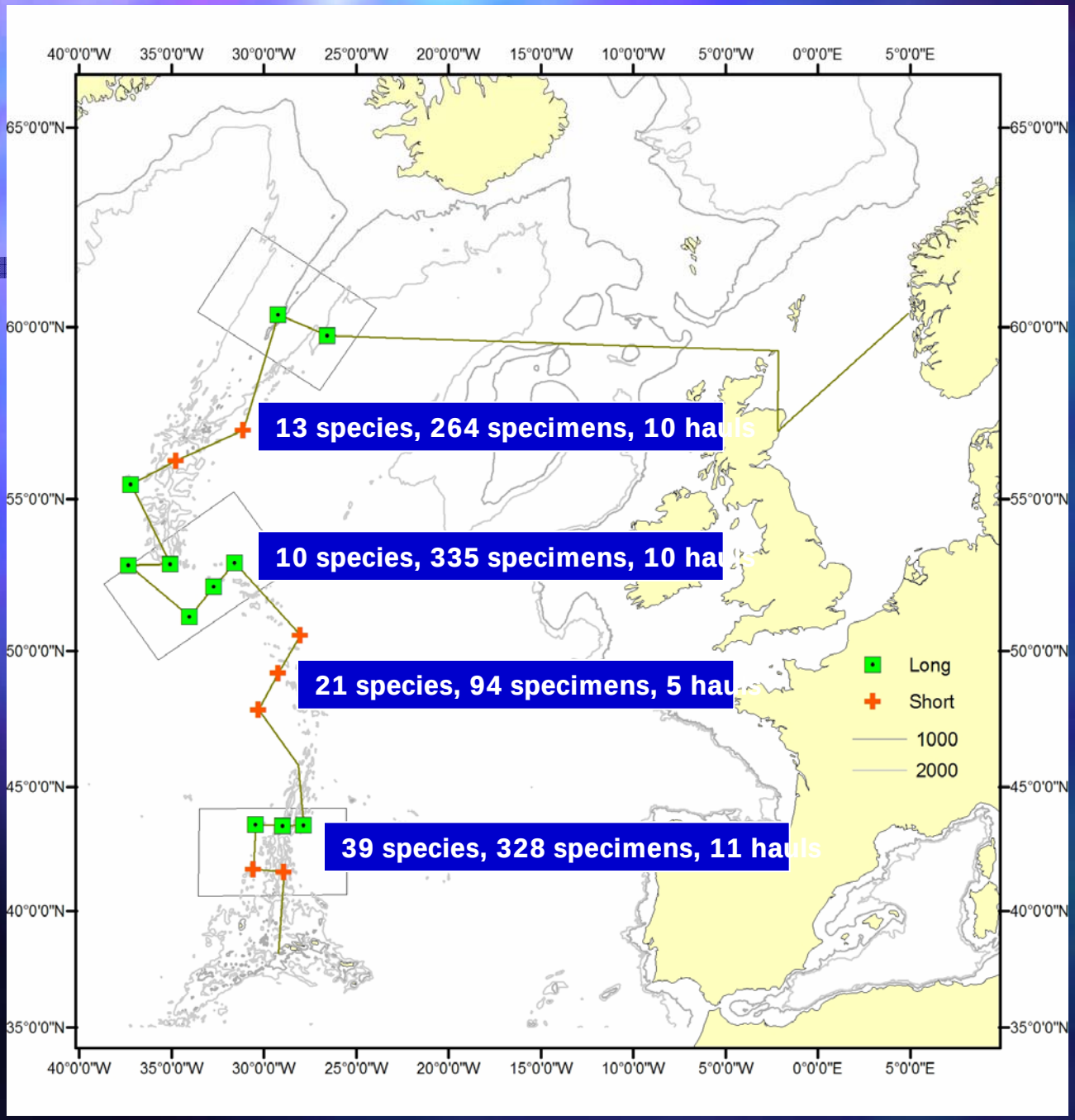
Species/Genus/Type	Number
Gonatus sp.	402
Mastigoteuthis sp.	95
Teuthowenia megalops	73
Stauroteuthis syrtensis	51
Pyroteuthis margaritifera	48
Heteroteuthis dispar	45
Lampadioteuthis megaleia	26
Bathyteuthis abyssicola	23
Galiteuthis armata	22
Ancistroteuthis lichtensteinii	21
.....	...
Bathothauma lyromma	1
Discoteuthis laciniosa	1
Grimalditeuthis bonplandi	1
Joubiniteuthis portieri	1
Promachoteuthis sp.	1
Total	1021

Cephalopods

1021 specimens
44 species/"types"
35 genera
25 families

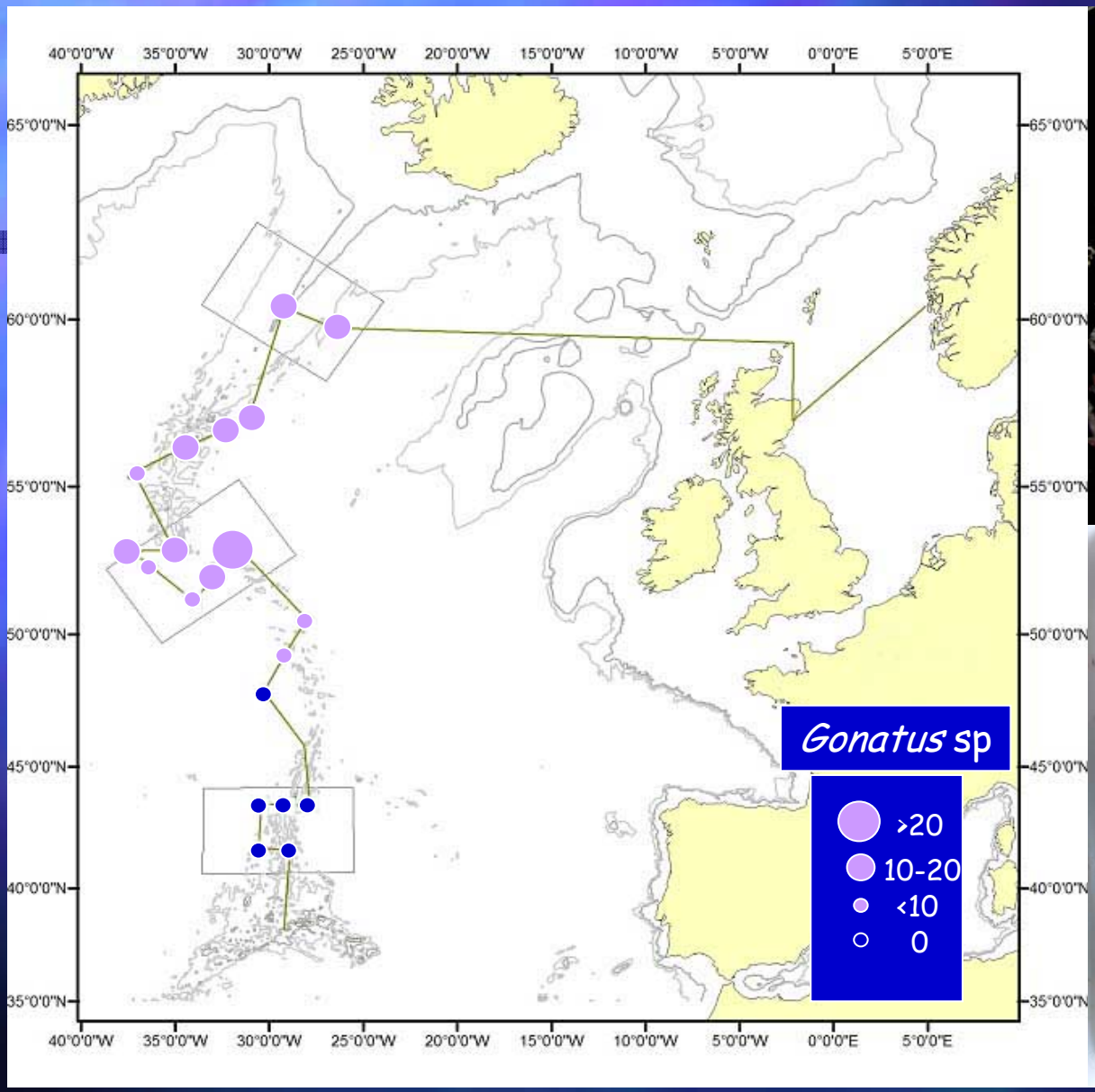
From all stations!!!
From all nets!!!

Krill-Trawl: 17 hauls
Åkra-Trawl: 15 hauls
Egersund-Trawl: 4(5) hauls



Cephalopods

Increasing
Species diversity
from
north to south: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60°0'0"N
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Gonatus sp
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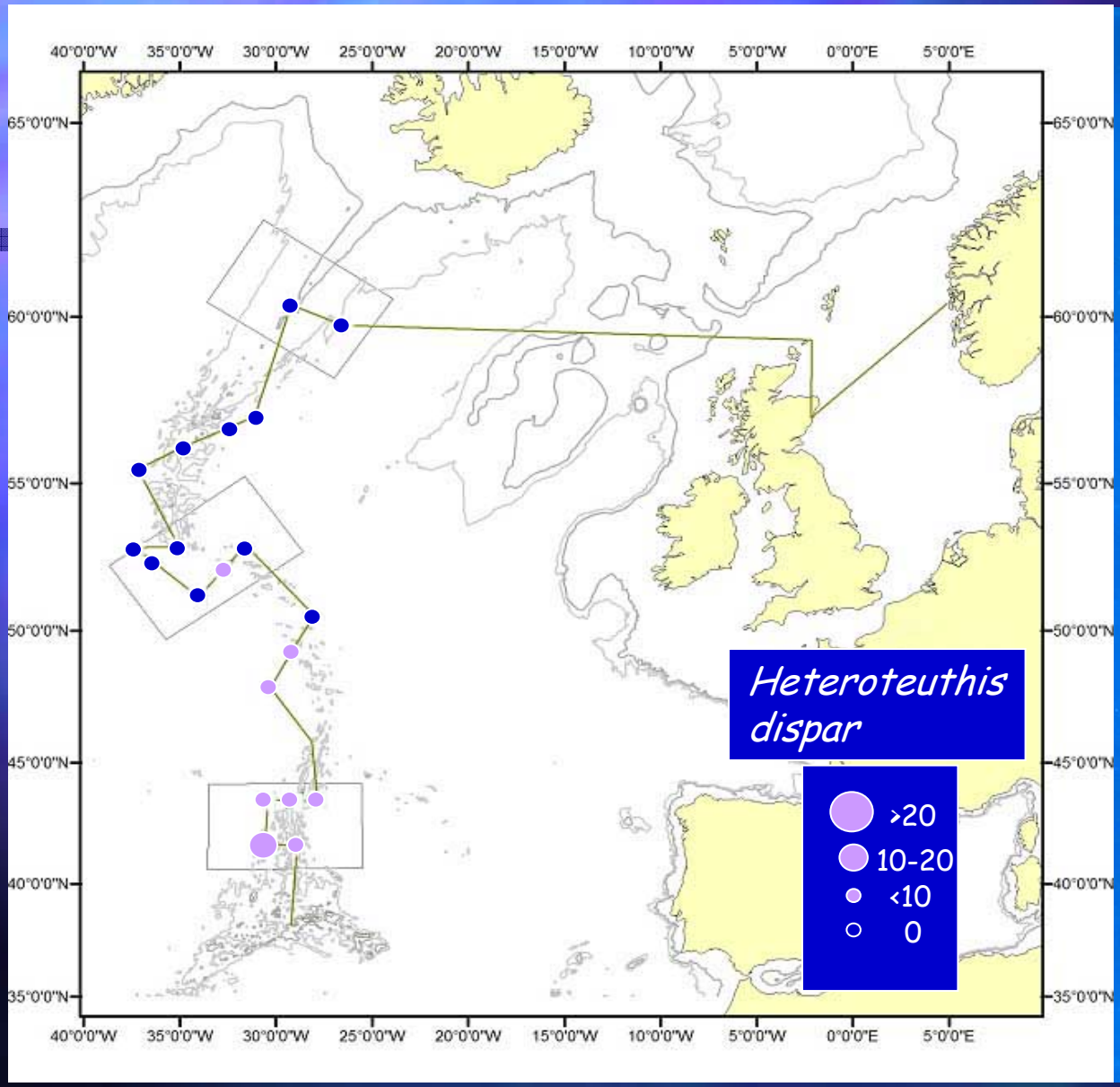
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10°0'0"W
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5°0'0"E
65°0'0"N
60°0'0"N
55°0'0"N
50°0'0"N
45°0'0"N
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Heteroteuthis dispar
>20
10-20
<10
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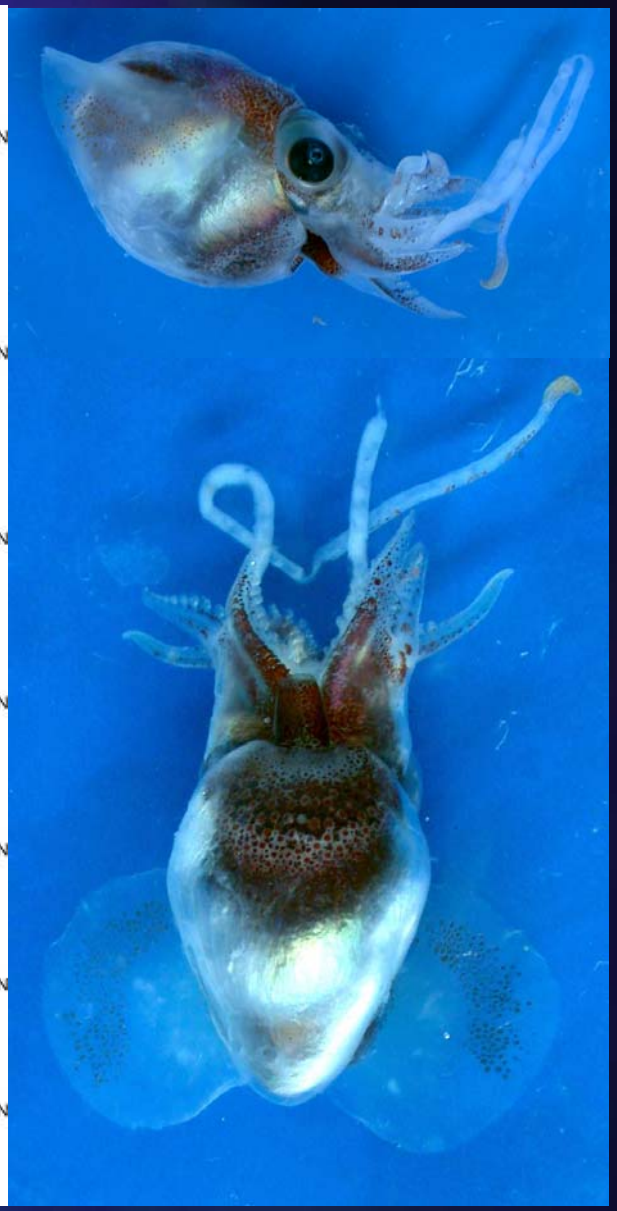

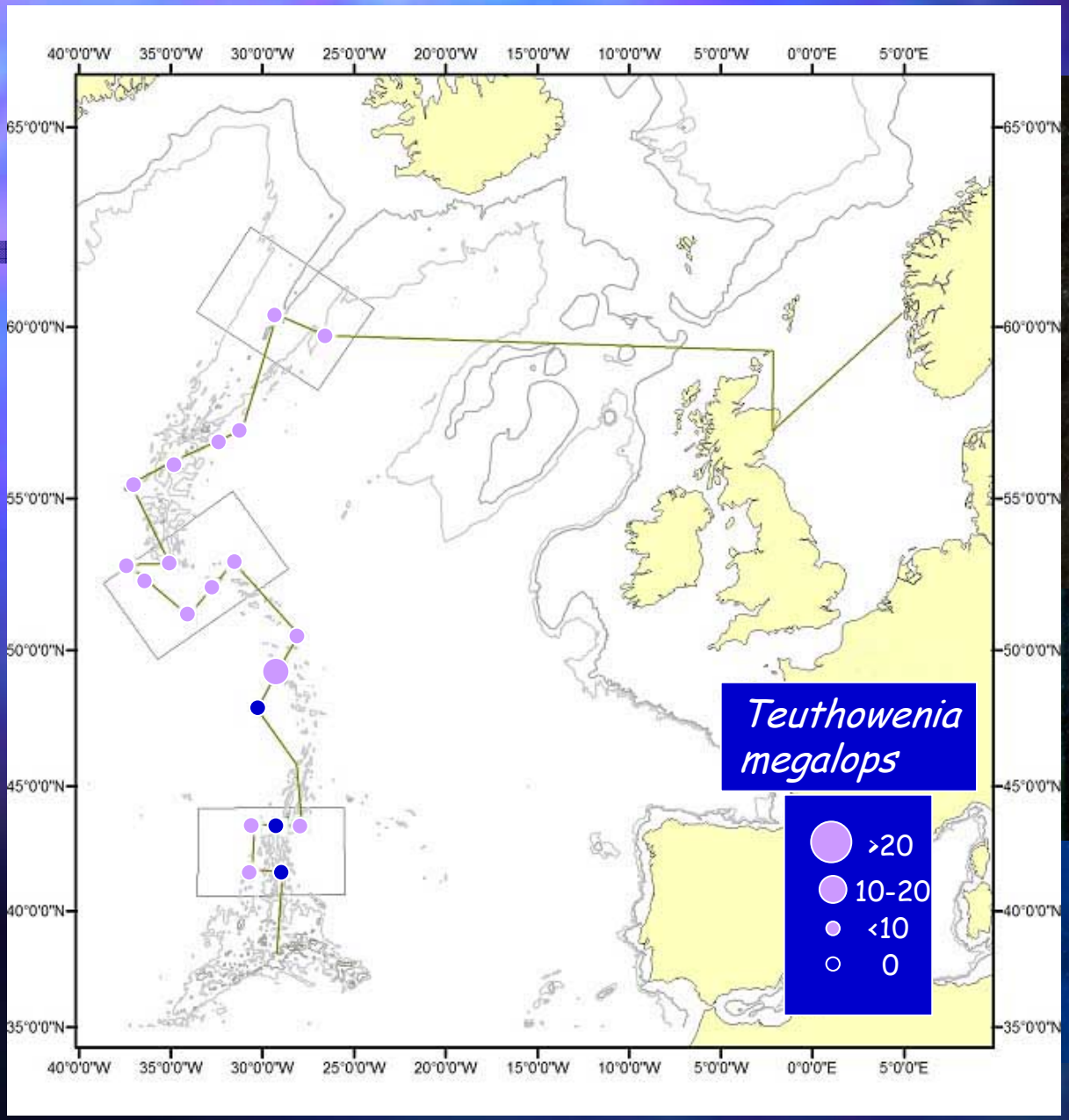
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Teuthowenia megalops
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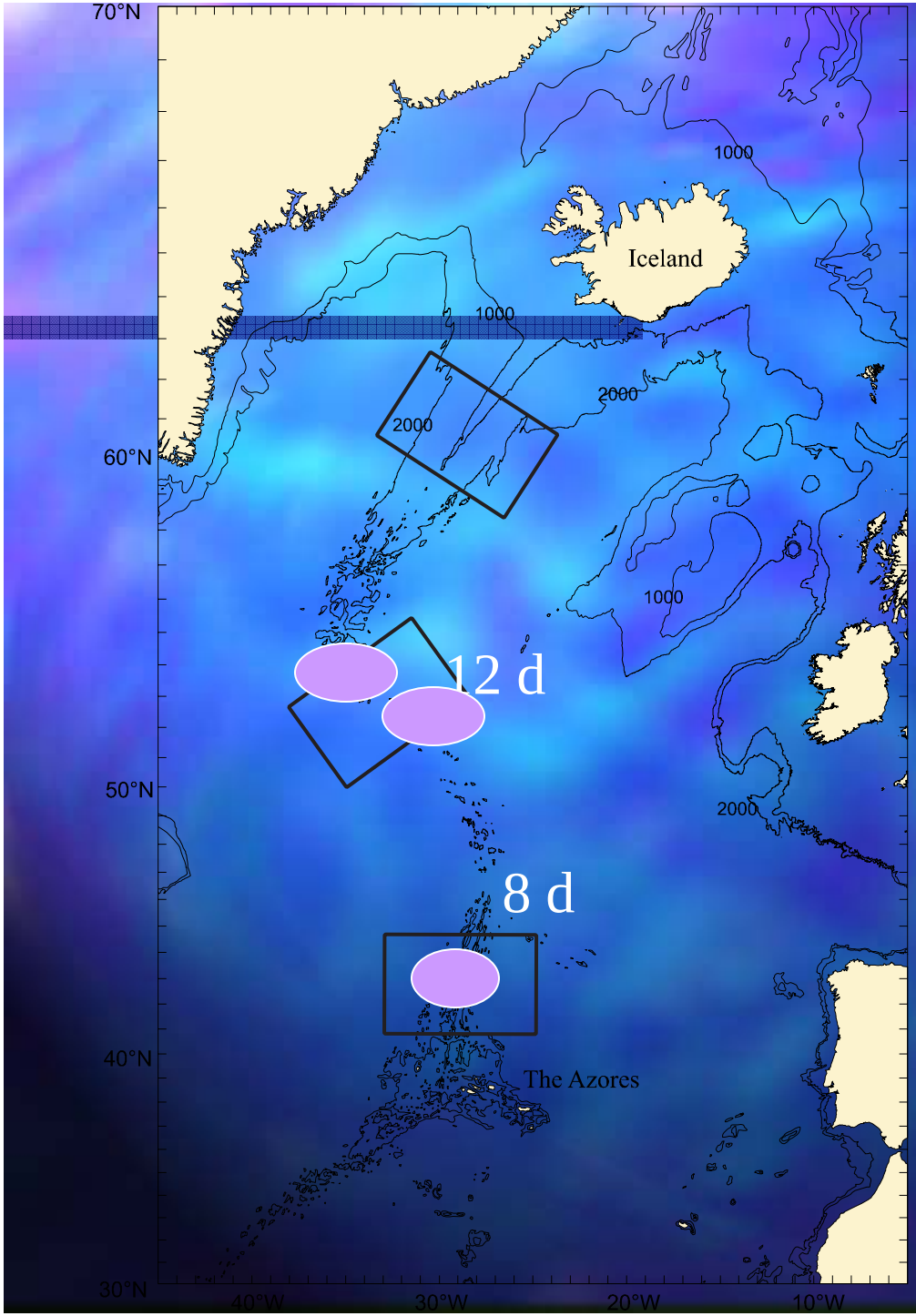
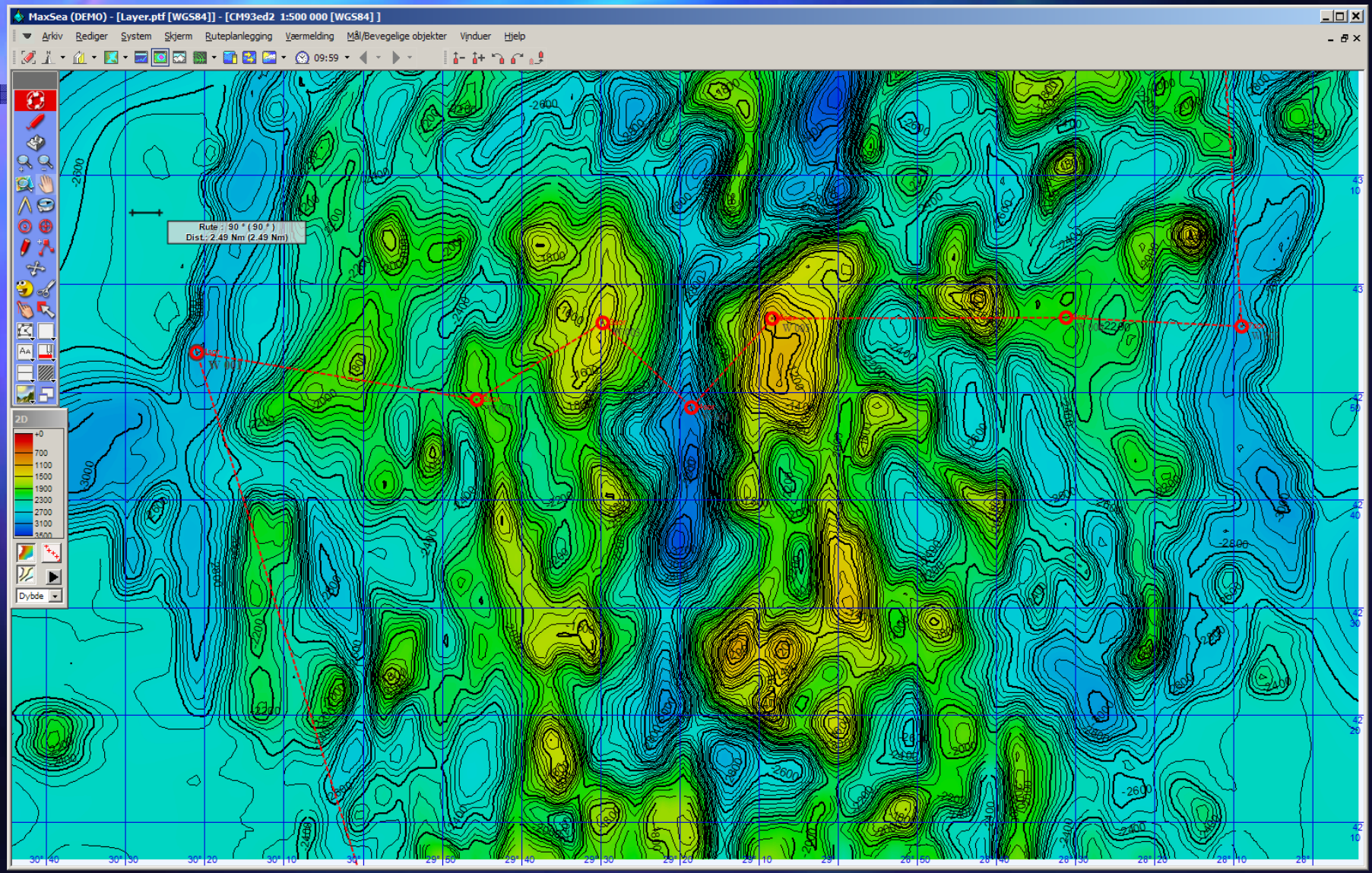


Second leg: sub-area studies, demersal nekton, benthos. (net and trap sampling, acoustics, ROV)

Southern box stations

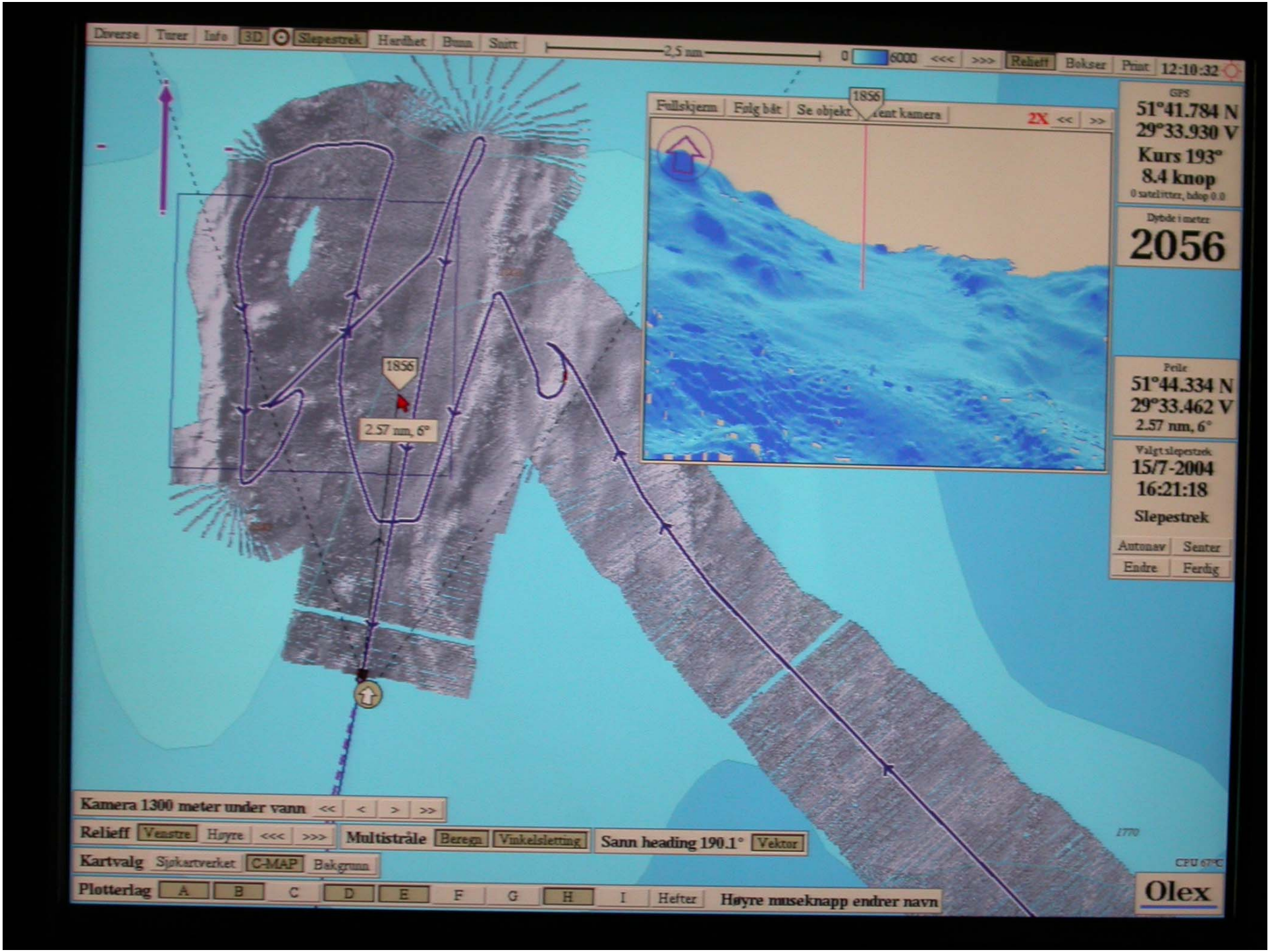


Schedule of work at (full) station

1) Pre-deployment bathymetry mapping (of rectangle).
2) Lander deployment.
3) CTD and UVP
4) ROV for demersal nekton components.
5) ROV for zooplankton components.
6) Trawling (at least one tow)
7) Lander recovery

Associated longlining and trap fishing

Total time at station: approx. 30 hrs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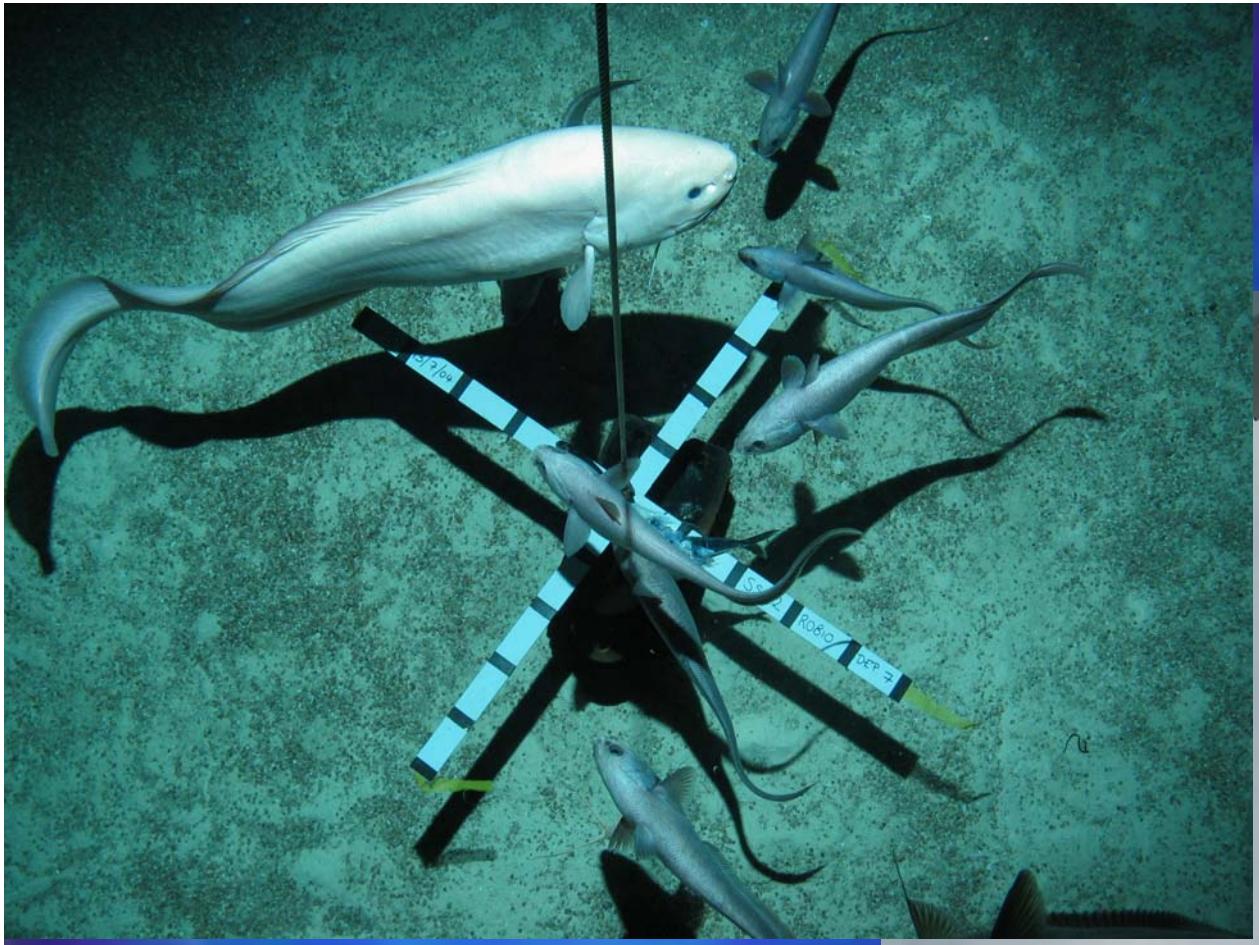
ROBIO
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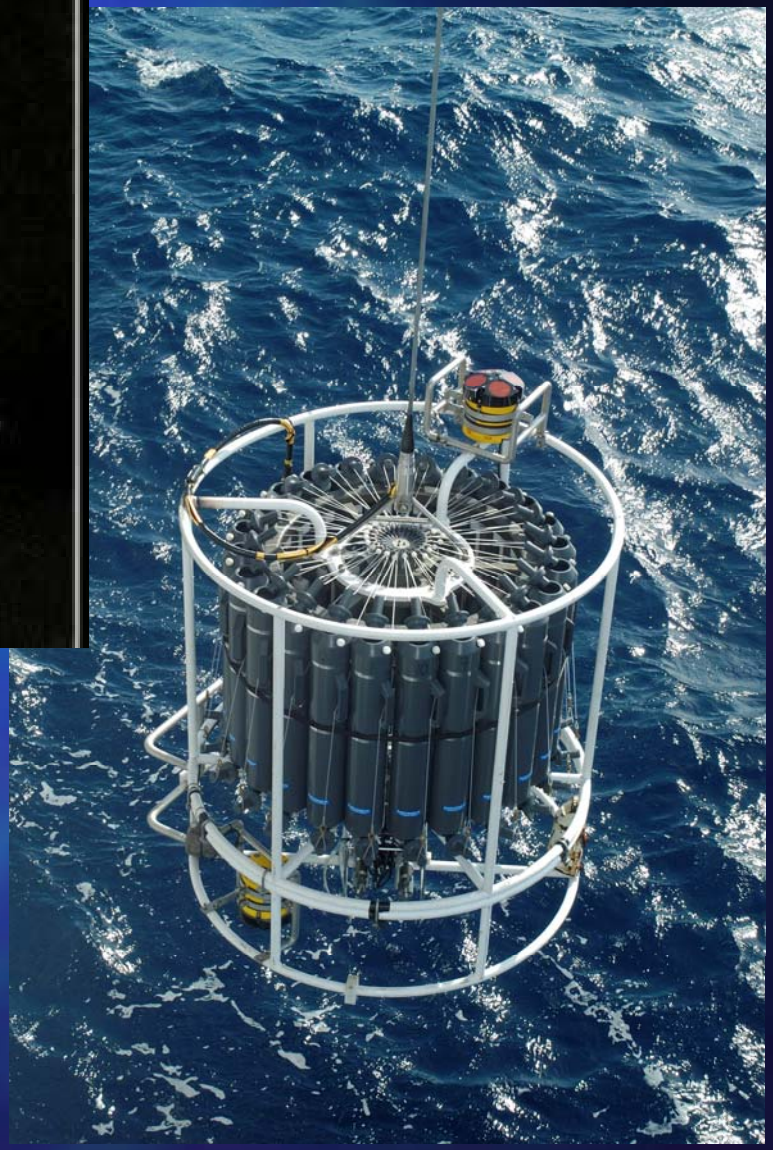

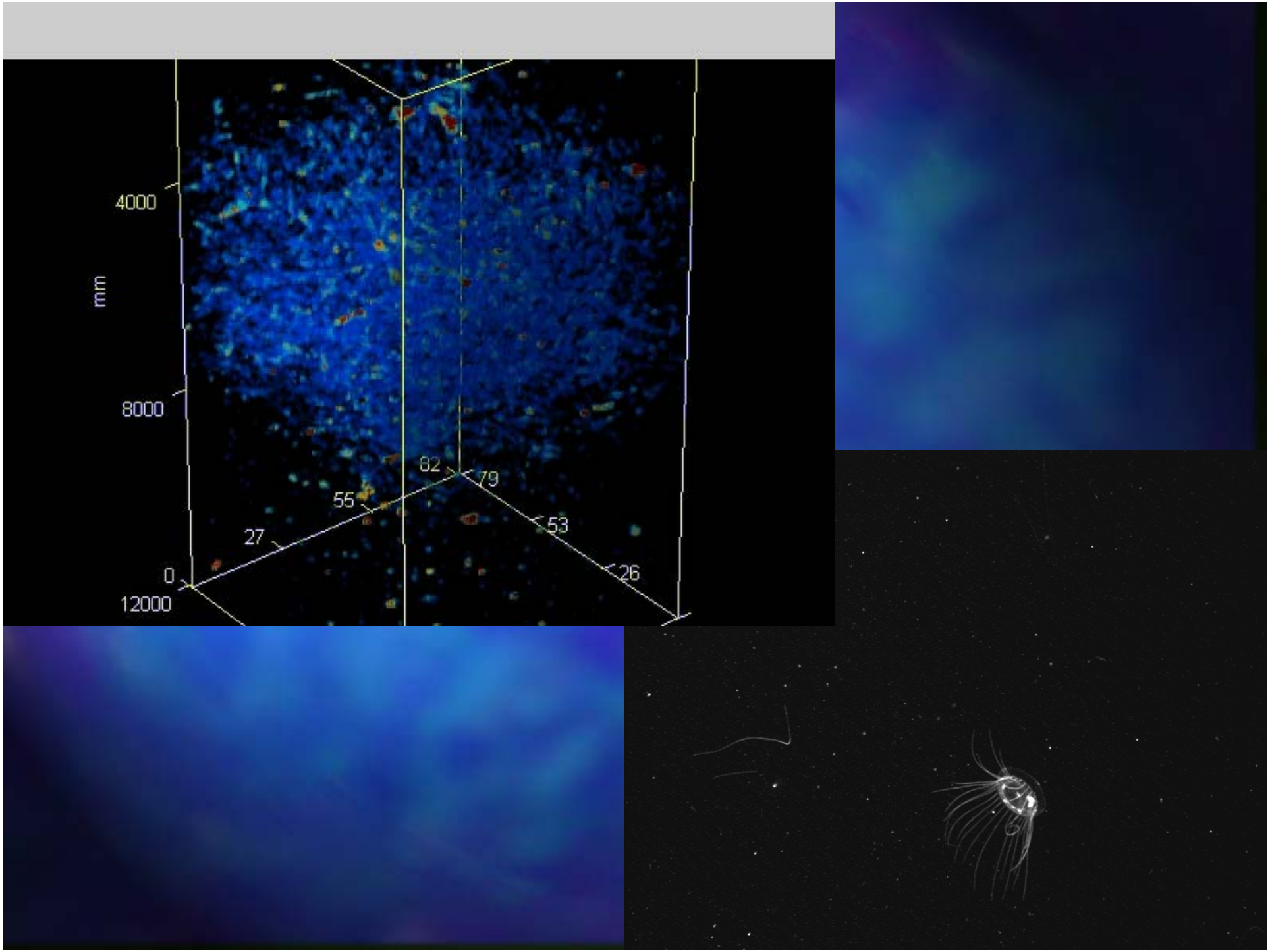
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RDV Aglantha
R/V G. O. Sars
Sal 35.08
Depth: 1295.35
Dive 16, S. Station 20
Temp +03.305





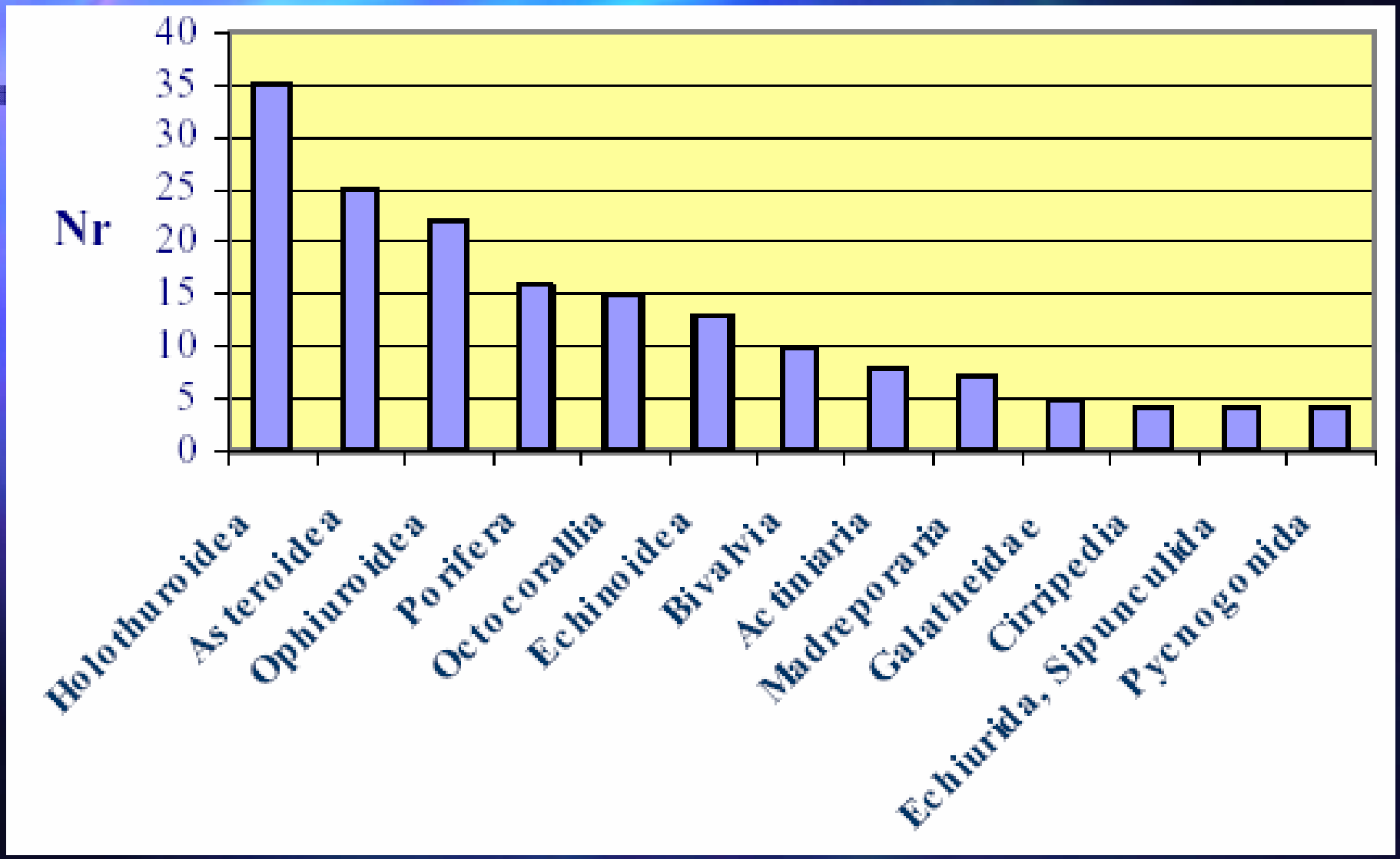




Bottom Trawl

- Campelen 1800 otter trawl, towed on double warps
- Wingspread: 12-14m
- Headline height: 4.5m
- Door-spread: 50m
- Cod-end mesh size: 22mm (stretched)
- Rockhopper ground gear
- Configuration and performance monitored by SCANMAR sensors
- Max. depth with available wire: 3500m at 1.5 knots towing speed

Species of Benthic Megafauna



Demersal fishes collected on 17 bottom trawl stations

70 species

+ at least 2 that are new to science.

22% of the identified species new to area.


MS *Loran*
LJWR
LORAN
ALESUND
Charter financed by Norwegian private and public fishing industry agencies, STATOIL, and NOAA/NMFS

- 87,500 hooks
  - 36 bottom and 22 vertical longlines
  - Traps and gillnets not very effective
- 8546 fish
  - 41 species
  - 17 families

Leg 2 Cephalopods

Strategy:

Any cephalopod , any time , anywhere

Trawl (including mesh)

Plankton net

Pelagic ROV

Benthic ROV

Material collected (leg 2):

240 specimens (148 preserved for BM)

17 families in 5 divergent lineages

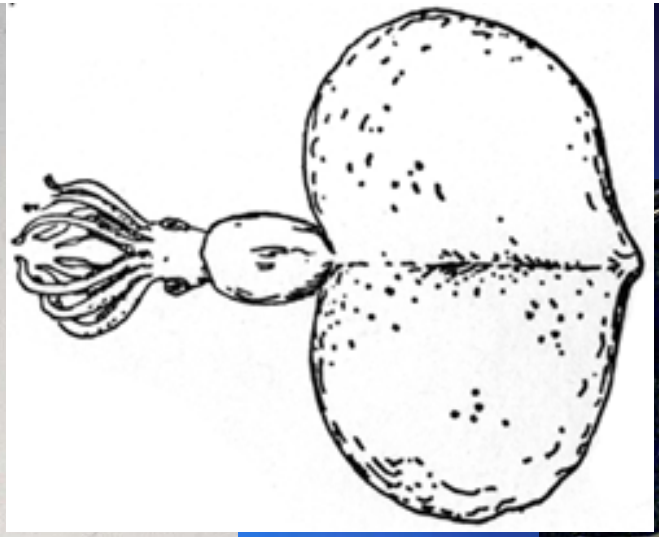
25 genera

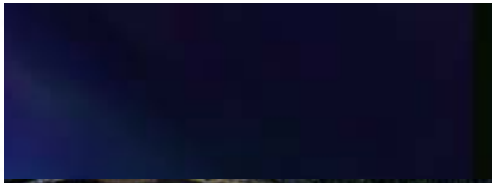
ca. 31 spp. (1 definitely new, 2 possibly)

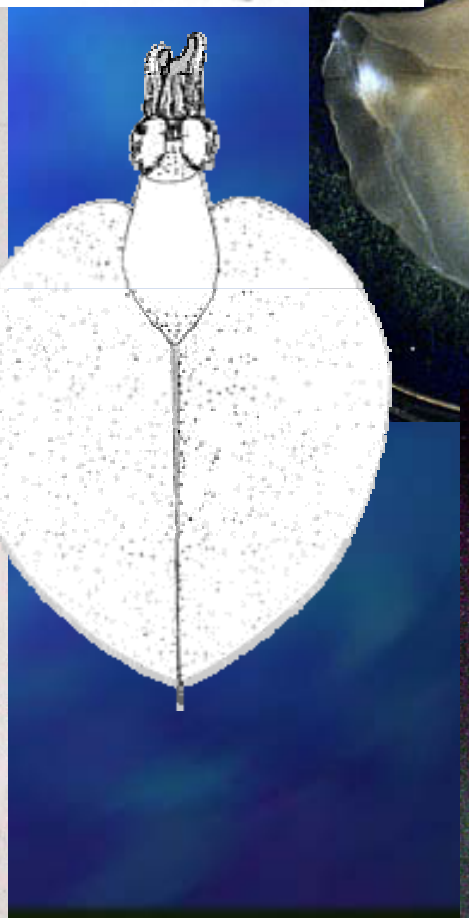
59 tissue samples from 29 spp.

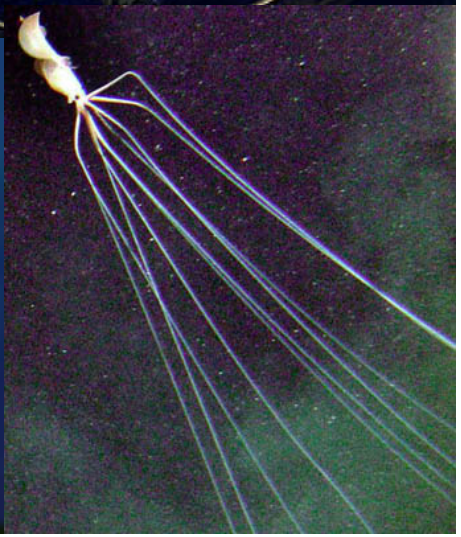
Photos of 29 spp., entire & anatomical

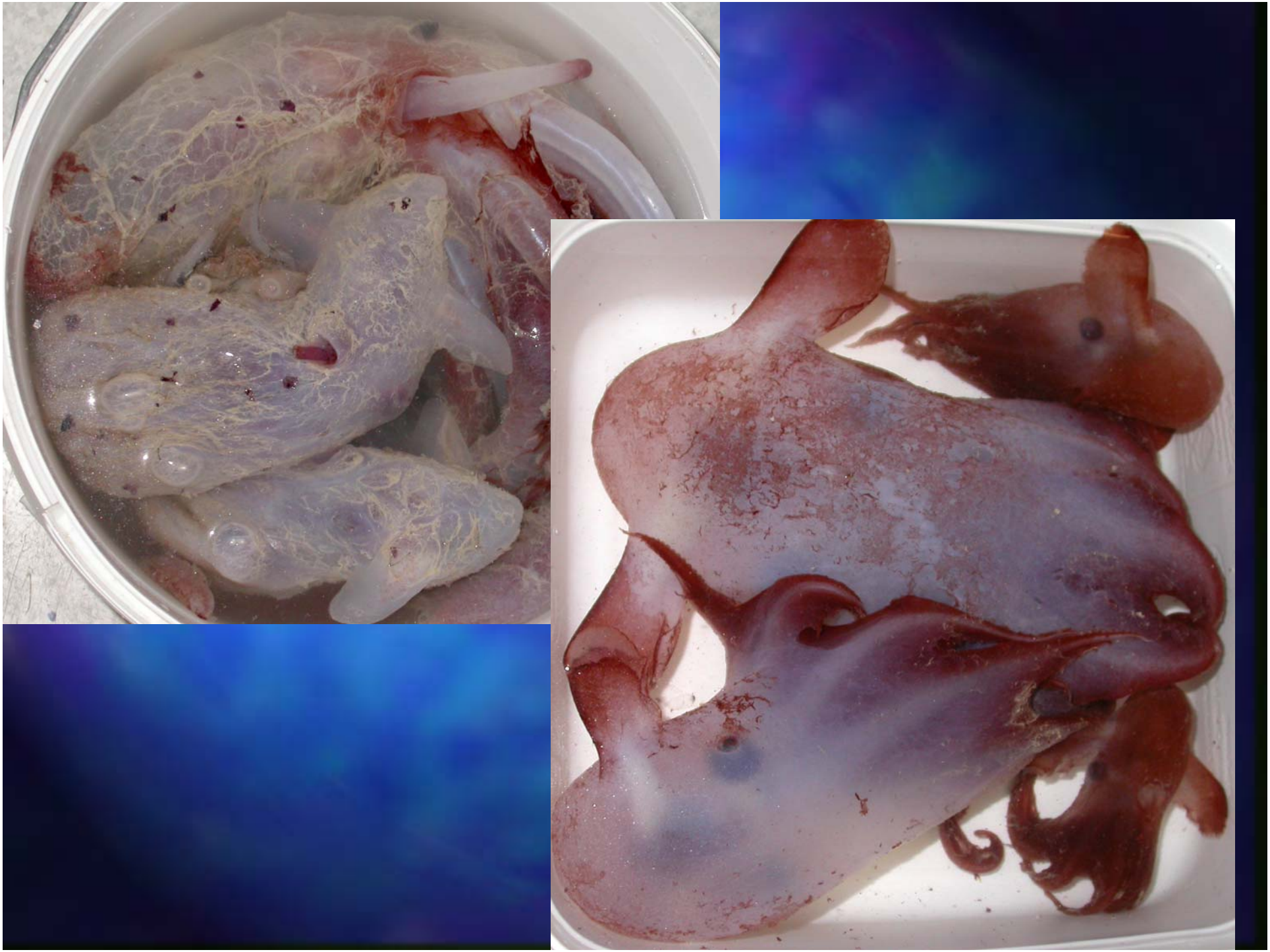
Big
Fin
n. sp.



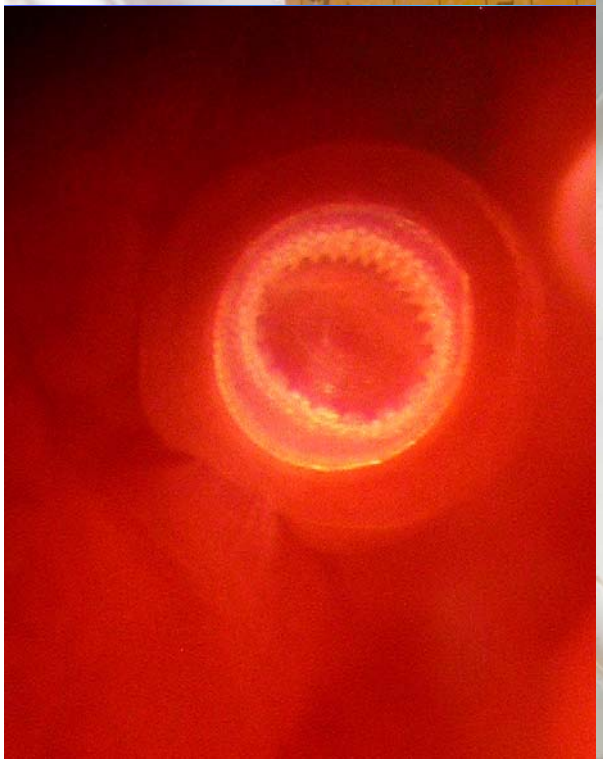






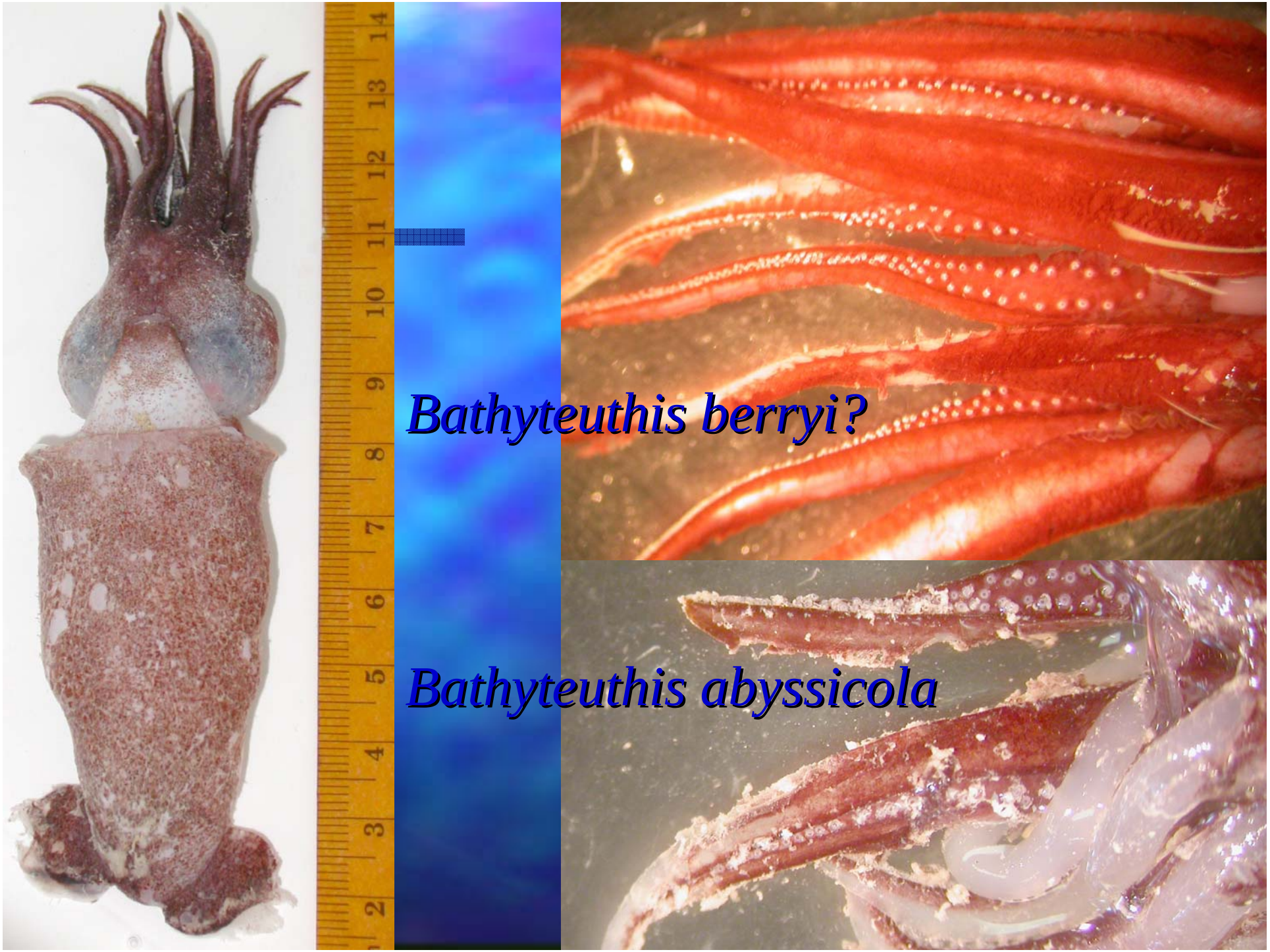


Mastigoteuthis sp.




Gonatus spp.

Opisthoteuthis spp.


Bathyteuthis berryi?
Bathyteuthis abyssicola

Comparisons among areas:

Southern box

total families	total genera	approx no spp.	total sta.	specimens
15	19	23	6	60

Farraday Seamount

total families	total genera	approx no spp.	total sta.	specimens
4	5	5	2	24

SE transect, CGFZ

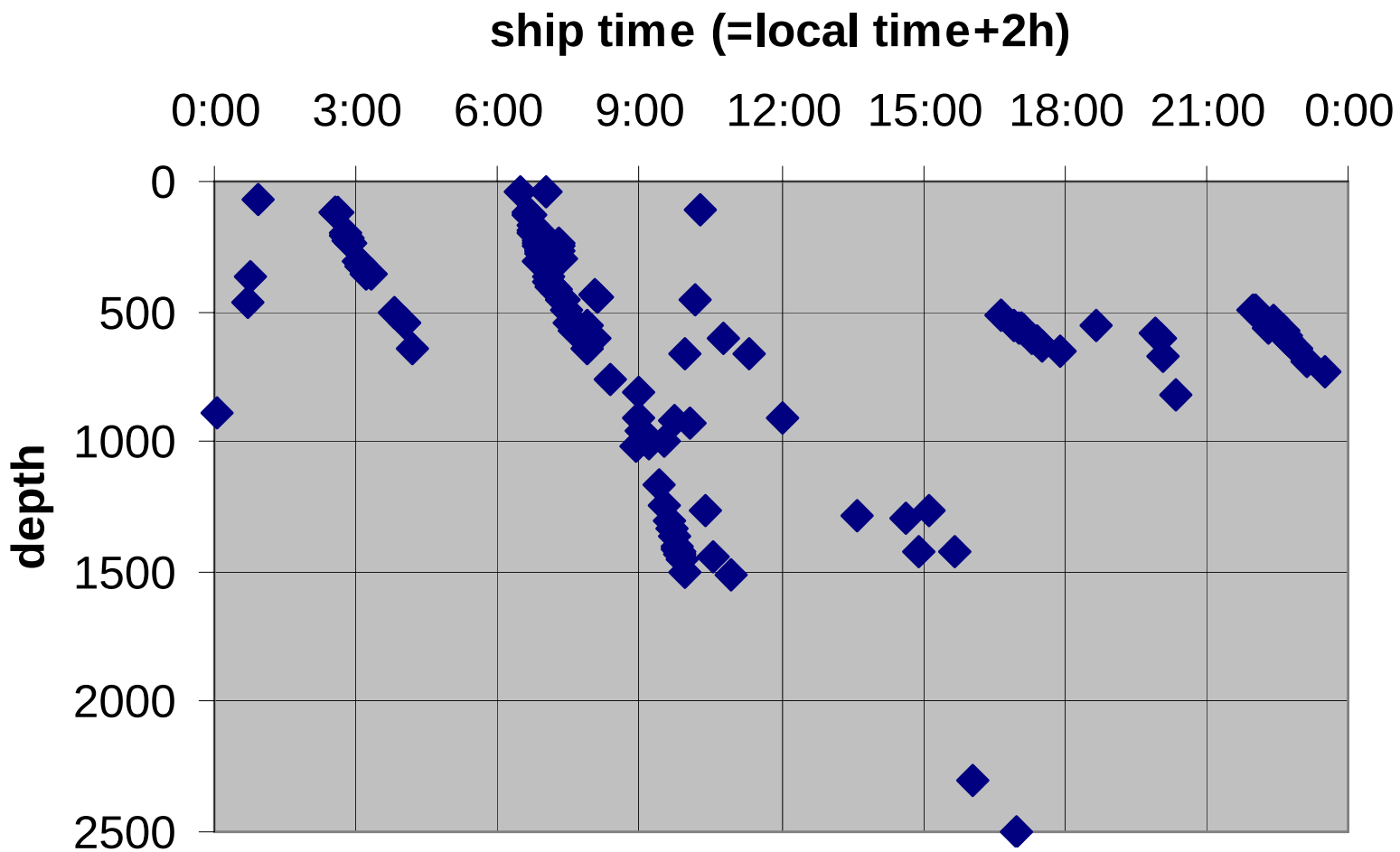
total families	total genera	approx no spp.	total sta.	specimens
8	9	10	6	103

NW transect, CGFZ

total families	total genera	approx no spp.	total sta.	specimens
8	10	11	5	53


ROV Aglantha
R/V G. O. Sars
Sal
Temp: +03.315

Squid ROV Observations - Middle Box



ECOMAR

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'Lophenteropneust' hypothesis refuted by collection and photos of new deep-sea hemichordates

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The deep ocean is home to a group of broad-collared hemichordates—the so-called 'lophenteropneusts'—that have been photographed gliding on the sea floor[1–8] but have not previously been collected. It has been claimed that these worms have collar tentacles and blend morphological features of the two main hemichordate body plans, namely the tentacle-less enteropneusts and the tentacle-bearing pterobranchs. Consequently, lophenteropneusts have been invoked as missing links to suggest that the former evolved into the latter[5]. The most significant aspect of the lophenteropneust hypothesis is its prediction that the fundamental body plan within a basal phylum of deuterostomes was enteropneust-like. The assumption of such an ancestral state influences ideas about the evolution of the vertebrates from the invertebrates[9–14]. Here we report on the first collected specimen of a broad-collared, deep-sea enteropneust and describe it as a new family, genus and species. The collar, although disproportionately broad, lacks tentacles. In addition, we find no evidence of tentacles in the available deep-sea photographs (published and unpublished) of broad-collared enteropneusts, including those formerly designated as lophenteropneusts. Thus, the lophenteropneust hypothesis was based on misinterpretation of deep-sea photographs of low quality and should no longer be used to support the idea that the enteropneust body plan is basal within the phylum Hemichordata.

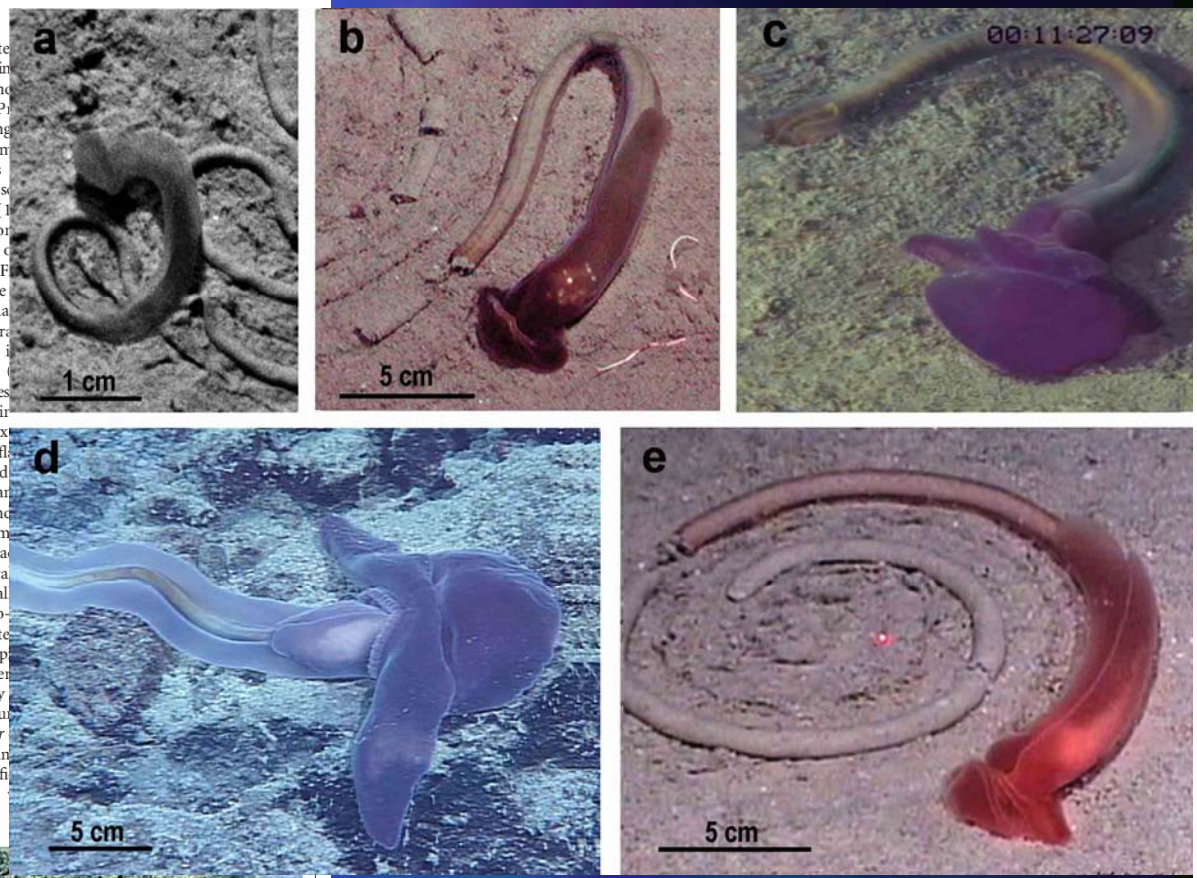
The recently collected enteropneust (Figs 1a, b and 2) is described below as a new family, genus and species in the class Enteropneusta of the phylum Hemichordata.

Diagnoses. Torquaratoridae fam. nov.: proboscis and collar each conspicuously broader from side-to-side than in their other dimensions (anteroposterior and dorsoventral); with prominent hepatic caeca, but lacking synapticles.

Torquarator gen. nov.: diagnosis as for family.

Torquarator bullocki n. sp. Description: Living adult 70 mm long and 15 mm wide through collar (smallest length-to-width ratio

known for any adult ente
life tan anteriorly, gradin
large white oocytes an
translucent body wall. P
conspicuously exceeding
sions (both about 5 mm
chord) and proboscis
posterior horns; probos
ring. Collar breadth (
dorsoventral dimensio
anterior end of collar
with midventral slit (F
spaces, and collar nerve
along entire length by la
and by dorsal and ventra
dorsal surface of trunk i
anterior third of trunk
hundred separate ovaries
oocytes (about 0.5 mm i
wall (Fig. 1a, b). Pharynx
region) dorsoventrally fl
ory region dorsally and
pharyngeal gill slits in a
midline with correspon
synapticles joining prim
(posterior 40% of gona
posterior zones (thin-wa
middle zone (thick-wal
traversing posterior two-
region anteriorly (pleate
caeca with overlying ep
followed by short poste
sphincter). In all body
epidermal mucus cells u
Etymology. *Torquarator*
arator (ploughman) an
collar region. The specifi
dore Holmes Bullock,



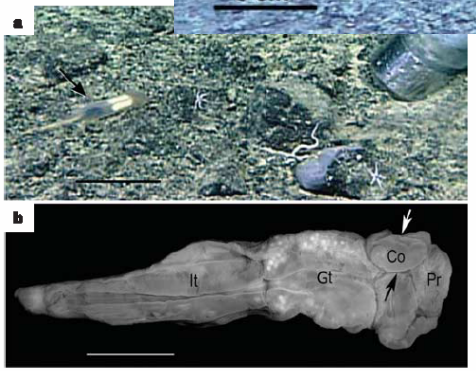


Figure 1 Holotype of *Torquarator bullocki* (Phylum He
a, Living specimen (arrowed) crawling on deep-sea flo
suction sampler (at right). Scale bar, 5 cm. **b**, Ventral
collection and fixation showing the proboscis (Pr), col
and intestinal trunk region (It); the black arrow indica
and the white arrow the artefactual compression of t
occurred during capture and fixation. Scale bar, 1 cm

Relevance to NOAA for management of deep-sea ecosystems and resources

- **Enhanced knowledge on status and impact on habitats and resources in exploited areas of the MAR, island slopes, banks and the continental slope.**

- **More information on life history strategies useful for evaluating vulnerability to exploitation (age, growth, fecundity, dispersal, migration).**

- **New information on population structure (stock identity) based on molecular genetics (study already started, sampling of reference material from entire range of several species).**

New insight, public awareness, enhanced competence

New techniques and technology, modern platforms

North Atlantic network of experts

http://www. mar-eco.no/

The End